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THE appointment of John H. Marble as secretary of the Interstate Commerce Commission, succeeding Mr. Moseley, seems like an excellent one. Mr. Marble has been connected with the commission some half dozen years and has appeared as its attorney in several important cases. He is now attorney for the United States Senate committee which is investigating the election of William Lorimer as senator from Illinois. Mr. Marble's work for the commission and in the Lorimer case has marked him as a man of ability. He is young, energetic and resourceful, and these qualities, as well as his experience as a lawyer, should make him valuable as secretary of the commission, for it seems likely that he will have special charge of the enforcement of the criminal provisions of the various statutes under which the commission acts. His predecessor had gained, whether justly or unjustly, a reputation for being unfriendly in his attitude toward the railways. This was due less to his activity in enforcing criminal statutes, for in this he was but doing his duty, than to his persevering activity in promoting the passage of laws which at times seemed intended to benefit railway employes only and not the public, and so framed that in the long run they were likely to injure railways without promoting the true interests of either employees or the public. Mr. Noble has the advantage that railway managers who know him personally or by reputation, while they expect him to enforce the laws vigorously, do not believe that he considers it one of his duties to promote legisation or so enforce laws as to further the interests of one class at the expenses of another. His former work has been such that railway men rather expect that he will consider it his duty to seek and promote only the interests of the public. With his comparative youth, his ability, his legal knowledge and his industry he should make an excellent record as secretary of the Interstate Commerce Commission.

THE value and necessity of keeping complete and accurate right of way records is conceded by all railway officers, but in actual practice this work is almost universally neglected to a greater or less degree. The indefinite and incomplete description of land is probably the source of most trouble. The common method is to tie a description into the located center line. Not uncommonly the location of the line is changed somewhat, or it is rebuilt, and it is but a short time until this original center line is lost and it becomes very difficult to follow the land description. As a general rule, when beginning construction or reconstruction, engineering forces are so rushed with preparatory matters that they are forced to reduce the work in connection with the purchase of right of way to a minimum, and after a deed is drawn and placed on record it is felt that there is not much use of taking further measurements. Giving a little additional time and labor to tieing the description into some permanent corner stone or monument would often later save many hours of fruitless surveys and troubles in court. Again, after property is bought it becomes very desirable definitely to locate its limits on the ground by properly marked corners while all the measurements and agreements are fresh in mind, especially if the property is located where land is valuable or where it is probable it will become valuable. When all the measurements are at hand it is but short work to set suitable iron or stone monuments at various corners, a section of old rail with one end driven into the ground making a cheap and serviceable marker. Such evidence becomes very valuable in later years in establishing or maintaining ownership. The third source of weakness in right of way records is often found in the system used for filing them. Their value is now so generally realized that they are placed in fireproof vaults, but it is equally important that it should be possible readily to find them when they are wanted for reference. Otherwise precautions for their safekeeping are of little value. Several methods are in use for filing and indexing them, probably the most common being that of grouping them according to the location of the land, as by counties, or similar

divisions. The method of indexing varies, but any method used should show readily where to find all papers relating to any particular tract of land. One convenient method is to plat on an alinement map all property owned by the railway and list on this the filing numbers of all records.

THERE has been an apparent conflict between the American Railway Association's car service rule 15, and the Master Car Builders' Association's loading rule 6 and interchange rule 2. This seeming conflict was remedied by action taken by the M. C. B. Association at its recent meeting. A clause was added to its loading rule 6 providing that in case of transfer or rearrangement of lading section D of the A. R. A. car service rule 15 will apply. Changes were also made in interchange rule 2, relating to loaded cars, providing that covered cars must, effective September 1, 1911, be accepted, A. R. A. car service rule 15 to apply. The only loaded cars the acceptance of which will be optional with the receiving line under the new M. C. B. interchange rule 2 are leaking tank cars and open cars where the lading is not properly secured on the car and where it exceeds the usual allowance of 10 per cent. beyond the marked capacity of the car. In other words, the right of rejection will, after these changes become effective, exist only in cases where the manner of loading is imperfect and not where the car itself is defective. However, to whatever extent leaking tank cars or open cars are accepted, A. R. A. car service rule 15 will apply. The cars which it will be permissible to reject under the new rule constitute probably less than 5 per cent. of the total number interchanged, and it does not appear probable that the right of rejection will be fully exercised in the case of open cars, as car service rule 15 fully protects the receiving road which accepts such cars. Even if the entire 5 per cent. should be rejected, 95 per cent. will be assured of a continuous forward movement. The reduction in the number of back-haul movements which often have been caused in the past by unnecessary rejections of cars will promote in no unimportant degree the efficiency of railway equipment, and eleminate a substantial amount of needless expense.

GOVERNMENT INVESTIGATIONS OF ACCIDENTS.

THE order of the Interstate Commerce Commission requiring fatal railway accidents to be reported to it by telegraph is followed by the establishment of a division, or bureau, to have charge of (1) the accident records, (2) the investigation of accidents, (3) the work of the safety appliance inspectors and (4) the records of the operation of the hours-of-service law. This bureau is in charge of H. W. Belnap, for eight years past one of the safety appliance inspectors, and latterly engaged in the negotiations between the government and the railways concerning the new safety appliance standards which have been established under the law of 1910. On the part of the government he was the chief negotiator and has thus become known to many railway men. For the detail work of investigating accidents Mr. Belnap is to call upon the safety appliance inspectors, of whom there are 24 scattered about the country. This consolidation of kindred functions in a single bureau is a businesslike move which ought to have been made long since. The boiler inspection service, however, is left out; presumably because the chief boiler inspectors are appointed by the president, and therefore are not entirely under the authority of the commission.

The plan for the investigation of accidents is liable to defeat itself by the scattering of its forces. There has been a public demand for federal inspection of accidents (and it has waited a long time for this answer) but, obviously, the need is for something beyond what is already possessed; something better than has been afforded by state commissions, coroner's juries and newspapers. These instrumentalities are weak for a number of reasons, but one of the principal ones is that no single state, or single authority, deals with enough cases to make its activities really impressive. The federal government, supervising 240,000 miles of road, is free from this drawback; but the 24 inspectors are likely to have the same difficulty nevertheless. Each one must labor under the disadvantage of having comparatively few important cases to study, and of having most of his time occupied with other matters. And the inspectors, as a body, will labor under the disadvantage of not being able to correllate their work effectively. An important element in the marked public usefulness of the British Board of Trade investigation of train accidents is the smallness of the number of investigators (four) and their free and frequent conferences with each other.

The word "important," as used with preceding paragraph, has a peculiar meaning. All train accidents are important, in the sense that each one involves risk to the lives of passengers and trainmen; but a public investigator has to select. He has to consider, first, whether a given accident is one that the public—that is, the law makers—can be made to take an intelligent interest in; and, second, whether the lesson of the accident is one which needs the elucidation that he can give to it. With the record of a thousand collisions and derailments each month, which we have in this country, he must shut his eyes to a large part of the cases that come to his attention even when his district has only one-twenty-fourth of the whole. For an example of the need of omission, look at collisions. The investigations of collisions which have been made by state commissions during the past five years have taken up at considerable length the operation of time-table rules and despatchers' and telegraphers' practices; yet all well-informed persons know that those questions are of a secondary nature, because it has been settled long since that time-tables, despatchers and telegrams are out of date as preventatives of collisions; that the block system is the only cure for such accidents.

The need of concentration of attention may be seen by considering the subject of enginemen sleeping in the cab. This weakness, or vice, is as old as our grandfathers, and every railway officer of experience has familiar knowledge on the subject. The government has an important duty to perform in studying this phase of the accident record and finding out which one of three conclusions is the right one; (1) The men are as good as can be had and the danger is too small, or too difficult to deal with, to require action; (2) the men can be improved or replaced by better men; (3) automatic train stops are needed. If the 24 inspectors could gather in one place and there see and talk with the 24 enginemen who during the next few months will get into trouble by sleeping on duty; if they would then give a frank and candid report of their findings, and could then have the right kind of an interview with 24 superintendents, some tangible result might be accomplished; but the plan does not seem to provide for anything of that kind.

Investigation of accidents by the government is desired not only by the traveling public but also by public-spirited railway officers. Both these classes want to have the work done by the highest talent available. High-minded ex-railway officers, worth $10,000 a year, would be none too good. Even assuming that public-spirited railway officers are not numerous and are afraid to speak, or indeed are kept down by other officers, not public spirited, there still remains two important functions that the government can perform for the railway manager, namely, that of an impartial judge between his subordinate officers, as when they will not agree whether a derailment is due to bad track or bad wheels, and that of an impartial judge between his superintendent and the grievance committee or the brotherhood leader when this superintendent is either overbearing, to the injury of the employes or cowardly to the injury of the company and the public.

In writing the foregoing, we have assumed impartiality on the part of the investigators. In order to get at the true facts and to get them presented in such a way that neither the employees nor the railways can effectively deny their accuracy and so that

the public may know the truth, it is desirable that investigations shall be made by impartial persons representing only the government. It was with the intention of securing such investigations that Congress passed the accident law of 1910. The original bill provided that either the Interstate Commerce Commission or any person designated by it might make the investigations. It was finally modified to provide that "the commission or any impartial investigator thereunto authorized by the said commission shall have authority to investigate such collisions, etc." Representatives of the railways who conferred with the committee of Congress having the matter in charge indicated that they did not feel it would be just to the railways to have the safety appliance inspectors, because of their labor union connections, make the investigations, and they understood, and railway men generally understood, that the words "any impartial investigator," indicated that the safety appliance inspectors and other persons belonging to the railway brotherhoods would not be employed in this capacity.

Mr. Belnap, personally, has a good reputation with railway men. They believe in his ability and in his disposition to be fair. He is the most competent inspector. But from every standpoint the employment of Mr. Belnap and other safety appliance inspectors belonging to the railway brotherhoods to make these investigations of accidents is extremely undesirable. Hardly ever does a serious accident take place out of which does not arise the question of whether defects in railway rules or equipment or shortcomings on the part of railway employees were to blame. It is not humanly possible that members of railway brotherhoods should impartially weight the evidence and decide as to where the fault lies. Even if the reports are both intelligent and unbiased they will not do as much good as the same reports would if they were made by men who had no connection either with the railways or the brotherhoods. If they are colored with bias in favor of the employees they probably will have no tendency whatever to remove the causes or reduce the number of accidents. Nobody connected with an investigation ought to have any reason for wanting to cover anything up or put any blame except where it belongs, and we do not believe that the action the commission is taking is going to provide the right kind of investigators or the right kind of investigation. And we believe that the blame really lies with Congress, which will not give the commission enough money to get the right men.

THE SOCIETY FOR TESTING MATERIALS.

THE American Society for Testing Materials, which held its fourteenth annual meeting at Atlantic City last week, has shown a healthy and almost phenomenal growth. The work of the association, like that of the American Society of Mechanical Engineers, includes so wide a range of topics that it is, in a way, handicapped by the very wealth of matter that is available. The discussions are disappointing in their meagreness. Papers are presented by men who are experts, while there are but few others in the room who know anything at all about them. On the other hand, most of the subjects would necessarily have been given short shrift had discussion been at all profuse at the recent meeting. The work laid out on the program was certainly very great. Nine sessions were held, and in those nine there were 58 reports and papers considered. Two sessions were held each day, of from two and a half to three hours each. It was too much, and the evident fatigue of those in attendance reminded one forcibly of the late M. N. Forney's remark, after a dull paper had been read, that engineers were very careful not to exceed the limit of elasticity in the stresses which they are wont to impose on the materials that they use, but fail to appreciate that there is such a thing as the limit of elasticity of an audience, yet there was always a sense that each subject was being hurried. Evidently the executive committee of the association has recognized this, as an announcement was made at the last session that a movement is on foot to limit the number of papers presented, as well as to place a more rigid censorship upon those that are accepted. Up to the present there has apparently been little or no scrutiny of these papers, for a glance through the program of this last meeting will disclose many subjects that are mere descriptions, simply catalogue work, that should have no place in the proceedings of such an association. In addition to this, there were a number of papers which gave in great detail a mass of routine laboratory work, that, while possibly interesting and having a bearing on the general work of the society, had not been carried to sufficient lengths nor were of sufficient importance to be of any great value, and were presented by men to whom the merits of the blue pencil and the art of condensation are unknown quantities. It might, then, be very appropriately suggested that the executive committee exercise a pretty rigid censorship over the work of the future and exclude that large and voluminous mass of matter that proves little and which no one reads.

It has been suggested that an ideal method of presenting papers to the association would be to have the subject matter, conclusions and recommendations presented in a readable manner, so as to be thoroughly understandable. All the detail tables, including the figures and tabulations of original data, would be compiled on separate sheets and filed in duplicate or triplicate in the office of the secretary or library of the society. Very few would care to consult this original data for a verification of the author's conclusions, and to those few the tables could easily be sent. This would place all the facts before the association in a discussable form and would save the expense both of tabular typesetting and of the bulkification, to coin a word, of the proceedings.

There is another thing which some members of the association show a disposition to carry to extremes. That is the standardization of specifications. Specifications are necessary, but it is not necesary that everything should be standardized; and when it is urged that a poor and confessedly faulty specification had better be accepted as a standard than that the society should have no standard, it really does seem, to an outsider, at least, as though that were carrying it a little too far. It should be remembered, too, that the association has no executive powers. Its standards are and must always be purely recommendatory. The work done by the association is of such value and of so high a character as to leave little to be desired. But the program could be improved by admitting fewer topics to its pages, and by subjecting those few to a closer scrutiny.

NEW BOOKS.

The Spontaneous Combustion of Coal with Special Reference to Bituminous Coals of the Illinois Type. By S. W. Parr and F. W. Kressman. Published by the University of Illinois, Urbana, Ill.

Bulletin No. 46 of the engineering experiment station of the University of Illinois describes a series of experiments directed toward the determination of the fundamental causes underlying the spontaneous combustion of coal. These causes may be summarized as follows: (1) external sources of heat, such as contact with steam pipes, hot walls, and the impact of large masses in the process of unloading, height of the piles, etc.; (2) fineness of division; (3) moisture; (4) activity of oxidizable compounds, such as iron pyrites. A historical review of the literature upon the spontaneous combustion of coal is given in the appendix.

Copies of this bulletin may be obtained gratis upon application to W. F. M. Goss, director of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

The Borsig Locomotive Works in Berlin last January received a contract for 12 locomotives for Japan—the first German engines to go to that country. The locomotives were wanted in a hurry, and they were ready for delivery in the short time of 66 days.

Letters to the Editor.

A RAILWAY EFFICIENCY BUREAU.

Chicago, June 26, 1911.

To the Editor of the Railway Age Gazette:

Replying to the criticism of M. W. Maguire, general manager of the Montana, Wyoming & Southern, in your issue of June 23, 1911, of my communication regarding the organization of a railway efficiency bureau or department, published in your issue of May 26, 1911, I beg to say that Mr. Maguire is evidently not informed as to the progress made on many of our larger railway systems today in the creation of efficiency committees and specialists who investigate and analyze railway operation in its various branches and report directly to either the president or vice-president of these systems. There is now scarcely a large system of railway that does not find it necessary to have such an organization; and the results accomplished have justified such action in every case.

The day of railroading by "rule of thumb" has ceased and railway operations must be reduced to a scientific basis. The recent action of the Interstate Commerce Commission in refusing the railways the right to advance their rates was based almost entirely on the evidence given at the hearing, that if the railway business were conducted as economically as could be reasonably expected, no increase in rates would be necessary. The railways naturally contradict the truth of the evidence produced in this case. Nevertheless, since the decision of the Interstate Commerce Commission, there have been organized on many roads efficiency committees, and methods have been put into operation to economize and increase the efficiency of railway operation to the greatest possible extent.

Mr. Maguire refers to the obnoxious character of what he terms a "smelling committee." From my own personal experience in organizing investigations of operations of large terminals on an important railway system, the fact is that such committees are welcomed rather than spurned, and any railway official who is loyal to the interests of his road will put aside any personal prejudice and be willing to accept any suggestions made that will tend to an improvement in the service. The railway officers operating properties do not own them, and if they are performing their duties conscientiously and fully they need have no fear of criticism; but, on the other hand, if their operations are the subject of proper criticism, it is their duty to put aside their personal feelings and accept what is not only to their own interest, but to the interest of the road as well.

We owe a duty to the stockholders and to the public, as railway men, to conduct the operations in our charge in the most economical and efficient manner and the criticism which carries with it a suggestion that is an improvement over former methods is always welcome.

It pleases me to say that in my own experience as a division superintendent in charge of about 500 miles of busy railway, with responsible charge of operation, maintenance and construction during a period of grade and line revision, whenever any investigating committee came to my division they were welcomed and heartily co-operated with, and the results secured were always an improvement. No division superintendent has universal knowledge of all subjects, and when his operations are reviewed from the standpoint of the experience and judgment of men who have had a wider experience and had more knowledge of what is being done on other roads, and whose opinions and judgments are not warped by the narrow sphere of a single operating division, there can be no question but that the results secured will be beneficial not only to the superintendent himself but to the railway.

How often have we seen old methods and practices perpetuated simply because they have been done that way before! One of my first duties as superintendent was to analyze the operations of a large freight station; and this condition of affairs was found to exist in that station to an alarming extent. No superintendent preceding me for years had gone into the details of the operation of this freight station, and the result was that work was being duplicated and that practices were being followed which were over thirty years old. A complete revision of the operation and performance of that station was made with most excellent results. I have time and again had the pleasure of having an agent at a large freight station inform me, after the investigation of the terminal committee, that he and his staff had secured much valuable information and were gratified with the results secured from the terminal committee's investigation.

I do not know what Mr. Maguire refers to when he mentions "stove committees," but our stove committee should be the president, our board of directors, stockholders and the public, and when a criticism is made it should be followed by suggestions that will remedy the matter criticised. What care we for the criticism of irresponsible persons who form the usual roundhouse or stove committees?

The American railways are operated for results, and personal feelings must give way to modern methods, and the railway officials who will face this fact and make a study of economics and efficient methods will be the ones who will reap the greatest benefits and show the best results.

One of the principal reasons why the operations of large industrial concerns is so successful today is the fact that they subject their operations to careful analysis and periodical investigation by organized efficiency bureaus. By the same token the railway operations today are what they are by reason of a lack of such a system. One of the greatest needs in railway operations today is the establishment of a department or bureau which shall specialize in this line of work and shall be charged with the responsible duties of devising ways and means of economic and efficient conduct of the operations in all departments of railways and shall enforce strict economy in the outlay of time and money, scrutinizing all expenditures to determine if the highest and best use is made in the disbursement of labor and material entering into its operation. While some progress has been made toward this end by the above mentioned committees among the officers of railways, and much good has resulted therefrom, anyone familiar with the operation of railways and the work of these committees is aware of the fact that such committees have not the time, as a rule, necessary to go into a thorough and complete analysis of the situation.

The organization of such a bureau or department should be along comprehensive lines, and should include within its scope all matters pertaining to inspection and the promotion of operating efficiency, and should be without interference from other departments as far as its investigation into their operations are concerned. Necessarily, therefore, such a department should be responsible directly to the president or other executive officer, but should co-operate to the fullest extent and without prejudice with every department for the promotion of general economy and efficiency in the service.

No matter how willing an officer in charge of a department may be to co-operate with other departments, departmental lines are, and will be, drawn to the detriment of the service. Such conditions can be met and remedied if properly investigated by an instrumentality which has for its object the improvement of the service as a whole.

When we consider that a division superintendent in charge of 500 miles of road may have charge of property representing from $25,000,000 to $50,000,000, does not the right exist that the owners of this property know that its operations are being judiciously conducted and the money expended to produce the greatest net results?

As a people, Americans are constitutionally extravagant in their tastes and expenditures; and this is true on railways as well as in our social life. The time has now come when rigid economy and greater efficiency must be enforced or the balance between the gross earnings and the expenditures will become narrower and narrower.

In most industrial enterprises the larger the plant becomes the more economical per unit is its operation. This is not true of the railway industry; the larger the system the greater becomes the opportunity for waste and loss which, extending over thousands of miles, in many cases aggregates enormous sums. On most of the smaller lines, where supervision by the highest and most competent authority is closer, this waste and loss does not occur.

I do not doubt that on Mr. Maguire's road of 22 miles of line he has his hands on the pulse of every operation and secures the greatest efficiency and economy from the expenditure involved. On a larger system, however, any one man spreads out very thinly over a thousand miles; and it is in such instances that he needs the help of others to enable him to detect the loss and the waste.

We are familiar with a recent case on a railway where, perhaps, a million dollars were lost to the railway through unscrupulous methods, a thing which could not have taken place if there had been the proper machinery for the inspection and review of the operations of this particular road. This instance cast a reflection upon every railway man in the country, both honest and dishonest; and it is against such practices that we must wage war so that we can present evidence that our operations are clean, conscientious, economic and efficient; and if we are able to prove this there will be no refusal to grant us our rights, whether they be in the matter of rate increases or relief from burdensome legislation.

Now that this question has been opened by Mr. Maguire I will suggest what a proper organization for an efficiency bureau or department should consist of, for a system of from three to five thousand miles.

In the first place, the department should be in charge of a man of exceptional ability in the railway service who has a general knowledge of all departments of railway operation and shall be constituted properly to co-operate with the other departments.

EFFICIENCY DEPARTMENT ORGANIZATION.

	Salary, Annual
Vice-president, in charge of department	$15,000
One chief clerk, in general charge of vice-president's office	3,000
One clerk	1,500
One clerk	1,200
Two stenographers	2,000
One engineer, in charge of engineering matters pertaining to roadway and tracks	3,600
One assistant engineer	2,000
One clerk	1,500
One clerk	1,200
One stenographer	1,000
One engineer, in charge of engineering matters pertaining to motive power, equipment and machinery	3,600
One assistant engineer	2,000
One clerk	1,500
One clerk	1,200
One stenographer	1,000
One inspector of transportation, in charge of transportation matters	3,600
One assistant inspector	2,000
One assistant inspector	1,500
One clerk	1,200
One stenographer	1,000
One statistician and accountant, in charge of statistics and accounting matters	3,000
One assistant	2,000
One clerk	1,500
One clerk	1,200
One stenographer	1,000
One file clerk	1,000
One office man	800
One messenger	500
Total 29 men	$60,900
Traveling expenses, rental, light, etc.	39,100
Total	$100,000

The operating expenses of a line of from 3,000 to 5,000 miles in length, range from $25,000,000 to $50,000,000, depending, of course, upon the density of traffic; by taking the average at $30,000,000, such a department would have to save only one-third of 1 per cent. per annum to cover its expenses. There is scarcely a road of this mileage in the country today which could not save at least three times that much per annum through the operation of such a department if properly constituted.

L. C. FRITCH,
Chief Engineer, Chicago Great Western.

THE SOUTHERN PACIFIC'S STUDENT-EMPLOYEE COURSE.

BY A STUDENT EMPLOYEE.

What is railroading? Is it a business or a profession? Or is it just swinging from a business to a profession?

While a business can be mastered by men endowed with great common sense, a profession can be mastered only by men trained in the theory and scientific nature of their calling, while still retaining the common sense needed by the man in business. Thus with the swing of any line of human activity from a business to a profession, must come a radical change in the method of training men for that activity. In a business, it is expected that a man will start in at the bottom, learning by dint of application and hard knocks the many lessons that will later make him a successful manager. In a profession, it is expected that a man will start by studying, for theory and sound reasoning are so essential a part of the professions that a thorough grounding in them must precede and accompany all his efforts to grasp success. Therefore, trained teachers, books, and a carefully prepared course of study, demand the first years spent in his chosen career. And then, when this period of preparation is completed, he too is sent out to work and gain experience, which will modify and enrich his theoretical training until he also becomes a man of sound judgment, who can cope successfully with life.

The Southern Pacific Company is, in its "Student Course in Railroad Operation," manifestly trying to consider railroading a profession, for it is adopting the professional method—that of teaching a young man the theory and thoroughly grounding him in it, before he is sent out to gather his practical experience. And still this is not wholly true, as I shall point out, largely from the exigencies of the case.

Up to the present time operating officials have come from any and all departments of the road, and even from outside employments. Our superintendents and general managers are chosen from among trainmen, enginemen, telegraphers, stationmen, trackmen, and shopmen, and as we go higher to the president's office the sweep of choice is even greater. But in it all one fact stands clear—that from whatever line they have come they are trained for a business, in the business way of requiring an education in the school of practical experience only. Very few, if any, have had any sort of a special training, studied out in every detail, to fit them peculiarly well to fill their high offices.

As a profession, the Southern Pacific Company is now adopting a system of theoretical training first, for its students. In any line where practical experience and practical knowledge is as essential as in railway operation, a course purely theoretical is both unwise and impossible. Impossible, because as yet the theory of transportation, its economics, laws, and historic growth are in the infancy of their development. Also the supply of good books is woefully small, and a corps of competent instructors "nil." So a course of combined theory and practice has been adopted which, as I have gone through it part way, has seemed more and more admirably suited to fulfil its purpose, in spite of some weaknesses not yet remedied.

The total length of the course, the division of time among the various departments, and the order in which the work should come, have all very carefully been studied out. There are naturally three main lines to be studied, one the business relations with the public, one the construction and maintenance of the permanent way, and the third the care and use of the rolling stock and power, which make possible the business career of the road. All other sides of the work, as the store, the auditor's office, etc., are simply accessories to these greater functions.

Ignorant, at the start, of the intricacies of this new world of work, the easiest, most natural, and most successful beginning can be made in station work. Here a student still sees a great deal of the public, with them his sympathies have naturally al-

ways been, and yet is led, step by step, to see the railway side of the picture. Here he sees the money coming in very rapidly, but soon is made aware of the great volume of expenses which these revenues must defray. In countless ways each day spent here slowly opens up the true character of his future work, while the needs of the public are also very much in evidence.

Later, a very abrupt change to track-work forces him to study the second great side of the work. Simpler than shop work, it is still so peculiarly a railway problem that his sympathy and understanding broaden rapidly, and he gets the railway point of view, while not forgetting the public view-point, and can study this side of railway expense that is so great and is yet so carefully guarded at every point.

So with the shop work and train service which follow. Each of these departments form one step in the progression to the more complex work of the succeeding departments, while together they form a group of the great functions of the road, to which may be added in turn study in the other minor departments, as rounding out the modern operating mechanism.

In brief, the course is divided into eight periods, devoted to the study of each department of the operating organization. The first period is six months in station service; the second, nine months in maintenance of way work; the third, six months in the car department and the shops; the fourth, five months in the train service; the fifth, two months with the signal department; the sixth, two months in the store; the seventh, four months with the auditor, and the final period, eight months with the trainmaster, in the yards and on the road.

Each period is subdivided to cover the various activities of each department. On reporting for the nine months in the maintenance of way work, at our Los Angeles office, I was sent out to the Yuma desert with a section gang for ten weeks. With only three white men and about twenty Mexicans within many miles, I certainly had no great distractions. The foreman saw to it that I learned to tamp ties, dress track, handle the jack, and raise joints. After a little he gave me two or three men and had me do the advance work while he finished up, calling me back when anything was wrong, and showing me how to do the work better and faster. Then he let me do all the work while he acted as censor. In the evening, after we had finished our housework, we would read and talk over the ideas explained in my text-books. Likewise on the bridge and building gang, to which I went for six weeks, the foreman expected me to do a full day's work along with the other men, but gave me every opportunity to move about from one task to another in order that I might have as complete a training as the time allotted me would permit. Then for five weeks I was sent out as an extra clerk in a roadmaster's office, for eight weeks was rodman and general assistant in the division engineer's office, for three weeks was material clerk and timekeeper on a steel-laying job, and finished my maintenance of way experiences with eight weeks as a section foreman, in charge of a branch section. And while I was thus learning the track work I also had an excellent opportunity to become acquainted with all that part of California.

In connection with all this work there are assigned books, bearing on the theoretical side of the work, which we must not only read but also report on each month, carrying the theory along hand in hand with the practical work.

In length of time spent in this preparation the course is longer than that of any of the professional schools. Unlike the post-graduate schools, the text-books, reports, and examinations are of minor importance, while we have no lecture or class-room work. The real object of the course seems to be the broadening of our interest and sympathy, and the increase of our ability, which is to be acquired by hard work in each department. To really learn the work of any department *in toto*, both theory and practice, is probably impossible in any length of time, and certainly is out of the question with only a few months for such study. But by doing the various kinds of work in each department as long as possible, under exactly the same conditions as the regular employees must meet, even in a few months a student can acquire a basis of knowledge that will stand him in very good stead in the future demands made on him to handle these departments on his division with the greatest intelligence and efficiency. Thus, by this practical work and daily study so closely allied, we ought to receive a far better training in the ground work of our profession than is given in any of the present-day technical schools.

From my standpoint, as a student, there are still two great obstacles encountered in the student course. The first one is the lack of good reference books and text-books, written by railway men. Men studying law, theology, medicine, or engineering need use only the books written by men standing, now or in the past, at the head of their profession. To them the books by outsiders lack the value that can alone come from a broad experience of a lifetime spent in the profession, and of such books they find no lack. But when we look for similar books in our line, with their almost priceless knowledge and information we find practically nothing. With few exceptions our books are written for us by outsiders, especially by different kinds of college professors, whose books must lack the stamp of practical knowledge of a railway which alone can insure any great value to them.

The second great drawback in the course is hardly less important. This is the misunderstanding of many of the officials of the purpose of this course, which we meet constantly. Brought up by a different method, they see few saving qualities in the student course, and give no more than necessary attention to any student who happens to be under them. The good that they could do the student by a personal interest in their work, and by occasional talks with them to point out new lines of observation and study, and the friendly correction of misdirected efforts and faults, is more imaginary than real, as I have never experienced it, but ought to be very great; while the inspiration to the student to greater effort, and the new enthusiasm obtained in such interviews, would be tremendous and influence his whole course for the better. This attitude is, however, less frequent than formerly, and will die out in time as the officers find out that we mean business and are making every effort to use our opportunities.

Special training has proven, and is proving every day, its superiority to the old "hit or miss" system of promotion and training. The supposition that an excellent master mechanic will make a good superintendent does not always prove true, as the work of the two positions is decidedly different. Further, we little know as yet what new standards of efficiency a man trained for a superintendent's or general manager's position will establish, and whether he may not be so much more effective, because of his theoretical and all-round training that, like other lines that specialists have entered, he will monopolize the field. If in engineering, science, and all the humanities, men excel in proportion as they receive a more or less complete professional training in their respective lines, why should not the law that special training makes for greater efficiency be universal and apply to railway operation as well as to these other lines?

As a college man with my own career to make, with success or failure dependent on my own efforts and ability, I have entered this student course, because I believe it opens to any man the finest opportunity in the east or west. From whatever angle you look at railway operation it is a big field, worthy of the best efforts a man can make, and calls for a variety of talents and a scale of ability found in no other industry. Its influence on public progress, and the spread of education and comfort is greater than any other agency. So as a field for public service and personal achievement, it appeals to me as the finest work that a college man can enter. And in this student course of the Southern Pacific Company we are given the opportunity to enter it by the most rational method yet devised, where scholarly habits and a college training are invaluable assets, and future success certain if we are able to measure up to the opportunities it holds out to us.

AMERICAN SOCIETY FOR TESTING MATERIALS.

The American Society for Testing Materials held its fourteenth annual meeting at Atlantic City, N. J., June 27-July 1. Some of the papers discussed are presented herewith. A few more will be published later. In his address to the society, President Henry M. Howe emphasized the desirability of standard specifications which should be international in their scope. He recognized the difficulty of reaching final results in such a matter because of the present apparent conflict between the interests of certain important countries; as in the case of rails, where the ore conditions of one country may force it to use the acid Bessemer process, while those of another may necessitate the use of the basic process.

"In view of this it would seem that the path of least resistance is to choose, for their earliest international specifications, not objects the composition of which is determined by the ore conditions of individual countries, as that of rails is; but, rather, objects which can readily give one and the same composition in all the great producing countries."

He urged throughout the whole address that whenever standards are adopted they should serve as standards of reasonableness of what is just and proper, and of what safeguards the buyer with the least hardship to the maker.

MANUFACTURE OF PURE IRONS.

The first paper on the program was the Manufacture of Pure Irons in Open-Hearth Furnaces, by Allerton S. Cushman. The pure iron described was the American ingot iron made by the American Rolling Mill Company, Middletown, Ohio. It will be borne in mind that Mr. Cushman is one of the chief advocates and exponents of the electrolytic theory of corrosion; his paper was written to show the possibility of obtaining a pure iron having great rust-resisting qualities on a large scale. In defining his position as to what he meant by "pure iron," the author said that he must not be understood to mean an absolutely pure iron, as that would probably never be produced commercially, but an iron that was pure when compared with other commercial products.

In following down the history of the manufacture of pure iron, he cited an analysis of the crude iron and the finished bar as produced at Ragdohar, Salem district, India. It shows the possibility of purity when the forging process is conducted with great care.

	Crude Iron.	Finished Bar.
Carbon	0.660 (Chiefly charcoal)	0.030
Silicon	1.113 (Chiefly slag)	0.010
Sulphur	0.005	Trace
Phosphorus	0.028	0.013
Manganese	0.013	Nil
Iron by difference	98.181	99.947
	100.000	100.000

The rust resisting properties of these old Indian irons are of world-wide repute, and it is interesting to compare this analysis with that of the ingot iron of which the author was speaking and note the close similarity between the two. The paper follows the development of the open-hearth process, and says that about 1903, H. H. Campbell produced an iron of the following analysis:

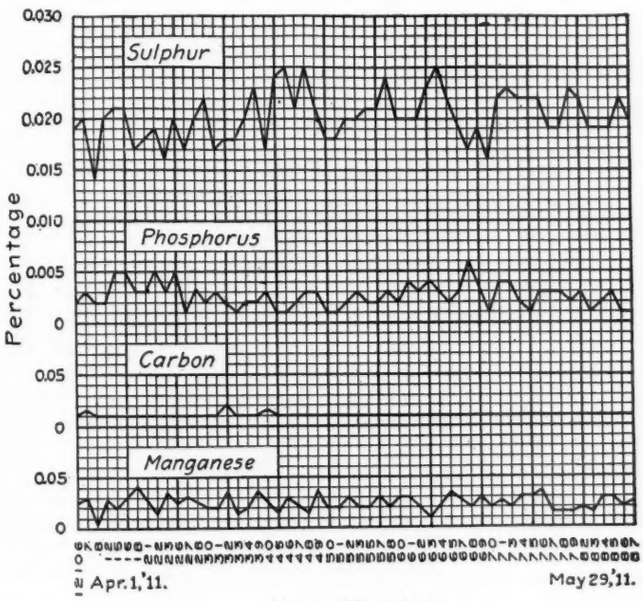
Carbon	0.025 per cent.
Phosphorus	0.009 " "
Silicon	0.005 " "
Manganese	0.040 " "
Sulphur	0.024 " "
Copper	0.100 " "

In commenting on Campbell's work, in the discussion, President Howe said that had the value of such a material been known at the time it was made it could probably have been produced in paying quantities, but it needed the work of Cushman and Walker and their investigation into the rust-resisting properties of pure iron to make the market and pave the way for the introduction of ingot iron on a commercial scale. This investigation was instituted by the Department of Agriculture, because of the complaints that had been made as to the rapid corrosion of fence wire and the greater durability of the older makes.

The investigation resulted in the conclusion that, though manganese does not segregate to the same extent as the other impurities, it is, however, somehow involved in the question of rust resistance. This is an opinion that practical men had already reached. At the time the report was made public, though there was a mass of literature bearing on the subject, there was very little actual experimental evidence.

It was this conclusion that led to the development of ingot iron. The material at first produced was simply a low-manganese mild steel. Then, when an attempt was made to eliminate the manganese entirely, the resulting ingots were of such an oxidized character as to leave the metal in a very unsatisfactory condition. But by the use of pig iron to burn out the oxygen, the ingot iron was produced. The general description of this metal has already been published in the *Railway Age Gazette* of September 30, 1910.

The following are a few analyses of normal ingot iron as it is being produced today, all of which serve to show the possibilities of this process in the production of pure iron. The analyses are extremely accurate, the carbon and the oxygen being determined



Typical Normalizing Curves.

by combustion with the special care necessary in dealing with the determination of such minute quantities.

ANALYSES OF NORMAL INGOT IRON.

	(1)	(2)	(3)	(4)	(5)	(6)
Silicon	0.003	0.002	0.005	0.004	0.006	0.003
Sulphur	0.014	0.015	0.019	0.017	0.018	0.014
Phosphorus	0.002	0.001	0.005	0.004	0.003	0.003
Carbon	0.009	0.011	0.015	0.02	0.016	0.008
Manganese	0.012	0.015	Trace	0.02	0.015	0.025
Oxygen	0.024	0.020	0.021	0.016	0.022	0.019
Copper	0.06	0.07	0.05	0.08	0.04	0.02
Aluminum	0.005	0.011	0.012	0.010	0.013	Trace
Nitrogen	0.006	0.004	0.005	0.003	0.005	0.007
Hydrogen	?	?	?	?	?	?

In order to simplify the matter of following the normal analysis of ingot iron on successive heats, the writer suggested the adoption of a system which may or may not be new. A record of the fluctuation in analysis of the various elements encountered is plotted out so as to cover the entire number of heats for a given period. The curves as produced are known as normalizing curves, and any departure from the normal practice is at once clearly shown. A number of the typical normalizing curves are shown herewith.

Considerable attention has been paid to the physical properties of this new iron, and comparisons between it and steel and the purer forms of wrought iron have been made. In tensile strength it closely approximates high-grade well-rolled charcoal iron, and in elongation and reduction of area it not only equals

but in many cases surpasses the finest soft steel. It is a well-known fact that iron is usually inferior to steel in elongation and reduction of area.

Owing to its more steel-like qualities in this respect, therefore, pure open-hearth iron becomes available for deep drawing and stamping purposes where very often ordinary wrought iron is unavailable and steel must usually be employed. The pure ingot irons, while perhaps not equal to mild steel under certain strenuous conditions, in most cases proved themselves to be adaptable. In fact, it is claimed for them—and reasonably so, it seems to the writer—that they appear to combine to a high degree the good qualities of both iron and steel, with a comparative absence of at least some of the undesirable qualities of each. The annealing, as well as the temperature at which the metal is delivered from the rolls, the rapidity of cooling, will all, of course, just as in the case of steel, exert a marked influence on the tensile strength, reduction of area, and elongation. In brief, it is safe to state that the tensile strength lies between that of iron and mild steel, the reduction of area being usually higher than mild steel, and the elongation about the same as mild steel.

In considering the right of the metal to the title, "Ingot Iron," he said, "that theretofore iron has been used to define metal having slag enclosures, but he maintained that from a purely scientific standpoint, when we use the word 'iron' we must inevitably refer to a product which, in all of its characteristics, essentially corresponds to the element itself, and this is exactly the case with ingot iron."

Again, in the discussion, President Howe differed with the author and maintained that the old distinction of cast iron, wrought iron and steel should be retained. Cast iron is a metal cast into shape and not malleable. Steel is a metal cast into shape and malleable. Wrought iron is a metal not cast into shape, and originally malleable.

As to the corrosion resisting properties, it is the consensus of opinion among investigators of this subject that the acid test should not be used as a true measure of corrosion resistance under service conditions. While much can be said in support of this point of view and while the writer does not believe that the acid test should be made the sole basis for specification, he has not the slightest hesitancy in recording the fact that *other things being equal* he would advise the purchase of material which showed well in the acid test, provided the prime consideration under the conditions of service was durability and longevity of the material.

There was but little discussion on the paper, but that little brought out facts as to the ease with which the metal can be welded, and its great value as the welding metal for the flowing-in process of welding as practised in the oxy-acetylene and electric arc methods.

HEAT TREATMENT OF ACID AND BASIC OPEN HEARTH STEEL.

The paper on acid and basic open hearth steel by Henry Fay was merely a detailed account of an investigation of two specimens of steel of nearly the same composition, to determine whether the superiority of acid to basic steel holds when the metal has been heat treated. The two steels chosen had the following composition:

	Acid.	Basic.
Carbon	0.430 per cent.	0.420 per cent.
Manganese	0.600 per cent.	0.600 per cent.
Phosphorus	0.027 per cent.	0.004 per cent.
Silicon	0.067 per cent.	0.033 per cent.
Sulphur	0.050 per cent.	0.055 per cent.

These two steels were made under the same conditions for similar purposes.

Tests on the original bars were made and gave the following results:

	Tensile Strength lbs. per sq. in.	Elastic Limit lbs. per sq. in.	Elongation on 8 ins. per cent.	Contraction of Area per cent.
Acid	85,400	43,700	20.31	43.2
Basic	73,500	37,700	25.00	39.6

The speciments were heated to 700 deg., 750 deg., 800 deg., 900 deg., and 1,000 deg., and immediately cooled in air. Both the tensile strength and the limit of elasticity of both steels rose with the temperature, but the difference was much less than with the original specimens. The heat treatment served to lower the acid steel about 7,000 lbs., and the basic about 1,000 lbs. in tensile strength, and the limit of elasticity about 8,000 lbs., and 4,000 lbs. respectively. The discussion showed that members were not disposed to consider such a meager test at all conclusive, and the question was asked as to whether, under the showing made, it would not be fair to assume that, had the two steels possessed the same physical properties at the start, the basic steel would have made the better showing under the heat treatment.

FLUE SHEET CINDER FORMATION IN LOCOMOTIVES.

The paper on Flue Sheet Cinder Formation in Locomotives was presented by Robert Job, and is published in full on page forty-seven.

STANDARD SPECIFICATION FOR STEEL.

The committee on standard specifications for steel presented four, as follows: For forged and rolled, forged or rolled solid steel wheels for engine truck, tender and passenger, subway and elevated railway service; for forged and rolled, forged or rolled solid steel wheels for freight car service; for heat-treated carbon steel axles, shafts and similar parts; and for steel reinforcement bars. In the specification for steel wheels, the range of permissible carbon content was from 0.60 to 0.85 per cent. A most decided opposition was raised to the proposition to submit the specifications for wheels to letter ballot, on the ground that the carbon range was too great and unnecessary. Attention was called to the fact that wheels were now being made satisfactorily and successfully under much narrower limitations and more rigid specifications, and that an increase was unnecessary. Further than this, so wide a variation in carbon would surely produce a wide variation in the hardness and consequent wearing qualities of the wheels. It was, therefore, necessary to consider the effect of the specifications on the two wheels of a pair rather than upon one only. While there might not be much difference between wheels made from the same heat, there would be a difference between those coming from different heats; and if one of a pair were hard and the other soft, the soft wheel would wear the more rapidly. The larger wheel would then run ahead, crowding the worn one to the rail, and a cut flange would be the result.

A representative of one road said that they recognized this difficulty and met it by mating wheels of the same heat. When asked as to how old wheels were mated, he replied that the heat number was stamped on the rim next the wheel number and that when wheels were removed they were stored by heat numbers and mated accordingly.

A strong plea was made for the specification on the ground that a great deal of time had been spent in drawing them up; that of course they were not perfect, no specifications could be, and that something, even an imperfect specification, was better than none. The reply was that while it was, perhaps, out of the question to draw up a perfect specification, it would be absurd for this association to submit a specification to letter ballot that was manifestly so undesirable as this one. The two specifications for car wheels were, therefore, referred back to the committee, with instructions to consult with the practical men of the railways who use and turn these wheels, and then submit a revision at the next meeting.

The specifications for axles were also criticised, because of the upper carbon limit, 0.60 per cent. It was urged, on the one hand, that the upper limit was too high and that there should be a lower also; and, on the other, that there should be no carbon specified at all. It was, however, voted to submit the specifications for axles and reinforcing bars to letter ballot.

The specification for axles is as follows:

PROPOSED STANDARD SPECIFICATIONS FOR HEAT-TREATED CARBON STEEL AXLES, SHAFTS AND SIMILAR PARTS.

1. Steel under this specification shall be made by the open-hearth or other approved process.

2. A sufficient amount of discard must be made from each ingot to insure freedom from piping and undue segregation.

3. The steel shall conform to the following limits in chemical composition:

Carbon	Not over 0.60 per cent.
Manganese	0.40 to 0.80 " "
Phosphorus	Not over 0.05 " "
Sulphur	" " 0.05 " "

4. Drillings shall be taken from the crop end of one axle, shaft, or similar part from each melt represented, parallel to the axis on any radius one-half the distance from the center to circumference, to determine whether the chemical composition of the heat is within the limits specified in Paragraph 3.

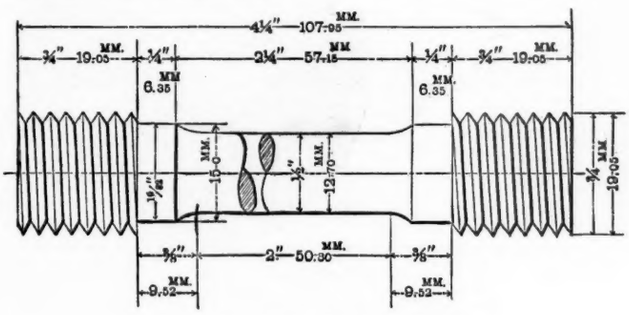
In addition to the complete analysis, the purchaser has a right to call for a phosphorus determination, to be made from turnings from each tensile test specimen, and the phosphorus must show within the limits called for by Paragraph 3.

5. The steel shall conform to the following minimum physical properties:

Ultimate strength, lbs. per sq. in.	85,000
Elastic limit, lbs. per sq. in.	50,000
Elongation in 2 ins., per cent	22
Reduction of area, per cent	45

The elastic limit shall be determined by extensometer. Above 40,000 lbs. per sq. in., each increment of load shall be not more than 1,000 lbs. per sq. in.

6. The test specimen as shown, 0.5-in. diameter and 2-in. gage length, shall be used to determine the physical properties as specified in Paragraph 5. Tests specimens shall be taken from the crop end of one axle, shaft, or similar part, from each treating-plant heat; if more than one open-hearth heat is represented in a treating-plant heat, a test shall be taken from each open-hearth heat represented. A full-size prolongation shall be left on each axle, shaft, or similar part.



Test Specimen of Axle Steel.

7. A cold bend test shall be made from the crop end of one axle, shaft, or similar part, from each treating-plant heat; if more than one open-hearth heat is represented in a treating-plant heat, a test shall be taken from each open-hearth heat represented. The test shall be made with a ½-in. square specimen, not exceeding 6 in. in length, around a flat mandrel with edges of ½-in. radius, and the specimen shall bend, without fracture, 180 deg. around the said mandrel.

8. Specimens for tensile test and cold bend test shall be taken parallel to the axis of the axle or shaft and on any radius one-half the distance from the center to the circumference.

9. In case the physical results obtained from any lot of axles, shafts, or similar parts, do not conform to those called for by paragraphs and 7, the manufacturer shall have the privilege of re-treating such parts, from which new tests shall be taken by the purchaser, and these shall govern the acceptance or rejection of the lot.

10. Each axle, shaft, or similar part shall be allowed to cool after forging, shall then be re-heated to the proper temperature, quenched in some medium, allowed to cool, and then re-heated to the proper temperature for annealing.

11. Warped axles or shafts or similar parts must be straightened hot; that is, at a temperature above 900 deg. Fahr., and before offering the parts for test.

12. All axles, shafts, and similar parts shall be free from cracks, flaws, seams, or other injurious imperfections when finished. Those which show such defects while being finished by the purchaser will be rejected and returned to the manufacturer, who must pay return freight.

13. All axles, shafts, and similar parts must be rough-turned with an allowance of ⅛ in. on surface for finishing, except on collar, which is to be left rough forged. Turning must be done on 60 deg. centers with clearance drilled at point.

14. The heat number shall be stamped on the rough forged collar. After rough turning, the manufacturer's name, heat number, individual axle or shaft number, and inspector's mark shall be stamped at place indicated by the purchaser, except at any point between the rough collars.

15. The inspector representing the purchaser shall have free entry, at all times while his contract is being executed, to all portions of the manufacturer's shop which concerns the manufacture of material ordered. All reasonable facilities shall be afforded to the inspector by the manufacturer to satisfy him that the axles, shafts, and similar parts are being furnished in accordance with the specifications. All tests and inspection shall be made at the place of manufacture prior to shipment and free of cost to the purchaser. The purchaser shall have the right to make tests to govern the acceptance or rejection in their own test-room, or elsewhere, as may be decided by the purchaser, such test, however, to be made at the expense of the purchaser and to be made prior to the shipment of the material. Unless otherwise arranged, any protest based on such tests must be made within six days, to be valid. Tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the mill.

STEEL TIRES.

A joint paper by Robert Job and Milton L. Hersey was presented, which was a study as to the causes of tire breakages. The general practice of the writers (after getting all the data obtainable regarding the conditions of service) was to take a transverse full section of the tire, as near as possible to the point of fracture or failure, making careful scrutiny of the polished surface to detect any visible defect. The section was then etched to develop seam lines and similar defects. Meantime, a standard test piece was cut from another portion of the tire and the usual tensile tests were made. A ⅜-in. section was next cut from the center of the transverse section and polished and etched for microscopic investigation, and another similar section was taken from the transverse section, and microscopic examination was made of a face one-half inch from the outside surface of the tire, for reasons which will be explained later. Borings were also taken from the tire for analysis, the carbon being determined by direct combustion in a current of oxygen in an electric furnace. Photo-micrographs were taken at a magnification of fifty diameters to determine the size of grain, that magnification having been found the most satisfactory for the purpose. Also, the hardness of the steel was determined with the Shore Schleroscope.

The number of tires tested has been considerable, representing the output of many of the mills, both here and abroad, and the general results of the study have been exceedingly interesting, and in many cases the cause of failure has been fully demonstrated, but in the brief time at our disposal we can merely touch upon the main findings.

A fair proportion of failures were due to radically defective composition, as for instance, tires which contained over one per cent. of carbon. The proportions of manganese, phosphorus and sulphur were generally within the usually accepted limits for tires. The carbon varied from 0.53 per cent. to 1.03 per cent.

Under the above conditions there was naturally a wide variation in the tensile properties of the steel, and in one case the metal had a tensile strength of 165,650 lbs. per square inch, with elongation of 10.9 per cent. in two inches, the proportion of carbon being 0.86 per cent., with granular size of about one-quarter

inch at fifty diameters. They also found a marked difference between the tensile properties of test pieces taken longitudinally, and those taken transversely from the same tire, as shown by the following:

	Tensile Strength (lbs. per sq. in.)	Elongation in 2 ins.
Longitudinal	157,000	9.3 per cent.
Transverse	126,700	2.3 per cent.
	Carbon, 0.795 per cent.	
Or—		
Longtiudinal	150,000	11.0 per cent.
Transverse	118,300	1.5 per cent.
	Carbon, 0.770 per cent.	

The hardness ranged between 37 deg. (0.83 per cent. C.) and 55 deg. (0.82 per cent. C.), and as would be expected, the degree of hardness found did not necessarily bear any direct relation to the percentage of carbon or of manganese in the steel, as in the examples just cited, these variations resulting evidently from changes in the physical condition of the steel due to differences in the heat-treatment.

In the granular structure, the index of the rolling temperatures, we found remarkable differences, as for instance, Fig. 1, which represents a tire which fractured in service, the composition being:

Carbon	0.649 per cent.
Phosphorus	0.057 " "
Manganese	0.697 " "
Sulphur	0.039 " "
Silicon	0.100 " "

In this tire the huge size of the grain proves that the tire was finished at an excessively high temperature, and that it was ill adapted to meet even the more ordinary conditions of service. Fig. 2 represents another very similar tire which also fractured in service. The size of grain is smaller, indicating a lower range of temperature, but the size is excessive and unquestionably a source of weakness. The composition was:

Carbon	0.539 per cent.
Phosphorus	0.052 " "
Manganese	0.781 " "
Sulphur	0.032 " "
Silicon	0.254 " "

In contrast with the above, Fig. 3 has been taken from a tire which had been annealed. The granular form is fairly fine, although the structure is rather irregular. It represents, however, steel of far greater toughness and power of resistance to shock than Figs. 1 and 2 shown above.

In the examination of tires which had not been defective in service, we found the usual range in composition. The hardness tended toward the lower figures, as for instance about 42 deg. to 47 deg. with carbon at about 0.70 per cent to 0.80 per cent. and manganeses at about 0.70 per cent.

The granular structure in such tires was usually fairly fine with granules at fifty diameters about one-quarter to three-eighths in diameter, though with the lower portion of carbon, e. g., 0.50 per cent., the metal was in some cases coarsely granular.

From the brief account which has been given it will be clear that the failure of a tire may be caused by any one of many variables, both in composition and in physical properties, as well as by changes induced by conditions of service, as for instance by skidding. It will also be evident that with metal which is subjected to the severe service which must of necessity be borne by the steel tire under present conditions, every feasible precaution should be taken not only to guard against unsoundness and incorrect composition, but also to avoid undue hardness and coarse structure. On the other hand, we must bear in mind that if a tough, fine-grained structure is secured by annealing the tires, the elastic limit of the steel is at the same time lowered and the tire is thus more liable to crush in service. The same condition was observed some years ago by one of the writers in connection with some service tests of annealed rails upon the Reading. (An account of this investigation apears in the Proceedings of the New York Railroad Club, December, 1906.) In that case eleven 90-lb. rails were sawn in halves, and one half of each rail was annealed, having the structure at center of head 50 diameters, shown in Fig. 4, as compared with the natural condition shown in Fig. 5.

After 88,000,000 tons' traffic, it was found that the annealed rails averaged 31.9 per cent. the more rapid wear, and that they also showed the greater tendency to mash down and splinter, but we found then on test that the elastic limit of the steel had been reduced from 80,600 lbs. per sq. in., to 70,225 lbs. per sq. in., the carbon averaging 0.54 per cent. and manganese 1.06 per cent. As was stated at that time in the paper referred to above, "the clear teaching of the trial was that under heavy traffic high elastic limit is essential to the best service, and it was also evident that if one proposes to get greater toughness and safety by some treatment, like the annealing, which lowers the elastic limit, one should also, to get the best results, increase the carbon or manganese contents of other constituents to the point at which the elastic limit will be high enough to resist crushing, even though the steel be somewhat unsound. In other words, the toughness and elasticity produced by the fine granular structure permit one to increase the hardening contents considerably beyond the point which otherwise would be safe, thus obtaining greater capacity for wear." If, for example, in a tire a carbon content of 0.55 to 0.65 per cent. is deemed sufficiently high with coarse-grained steel, it may safely be assumed that with fine-grained steel the proportion of carbon should properly be increased, say to 0.65 to 0.75 per cent. or perhaps higher, and with far greater chances for safety with the latter quality than with the former with its brittle coarse-grained structure.

In the inspection of tires it has been customary to take a tire at random from a shipment and subject it to a drop test. This practice, of course, gives an indication of the quality of the one which is selected for test, but it does not do so, unluckily, as to that of its mates which go into service, and upon that account other supplementary tests are necessary. A section for tensile test cannot be taken from a tire without rendering the latter unfit for service, but we have found it entirely feasible to take a section for microscopic work in such manner that the service value of the tire is not in the least impaired, and a study of this

Figs. 1 and 2—Locomotive Tires, fractured in Service; Center of Tires.

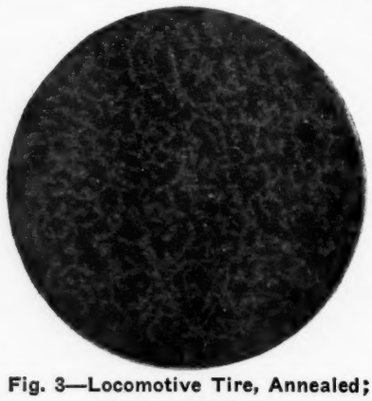


Fig. 3—Locomotive Tire, Annealed; Center of Tire.

section gives a clear idea as to the heat treatment which the tire has received at the mill.

In our first experiments we took sections from the edge of the tire at a distance of ¼ in. from the surface, but we quickly learned that such a section might not indicate the condition of the metal beyond the immediate surface of the tire. We found, however, that by taking the section at a depth of ½ in. from any surface of the tire, a very clear indication as to the character of the granular form at the center of the tire could be obtained, and the relative difference in size of grain, at the center, and at ½ in. from the surface of the same tire is shown in Figs. 6 and 7, the former being at the center of the tire. The analysis was as follows:

Carbon	0.53 per cent.
Phosphorus	0.037 " "
Manganese	0.54 " "
Sulphur	0.030 " "

In Figs. 8 and 9 a similar example is given of a coarse-grained steel, Fig. 8 being from the center of the tire and Fig. 9 from a point ½ in. from the surface. The composition was:

Carbon	0.83 per cent.
Phosphorus	0.077 " "
Manganese	0.47 " "
Sulphur	0.049 " "
Silicon	0.21 " "

We found also that a test section sufficiently large for the purpose could be obtained by boring into the tire with a hollow drill of special steel with walls not exceeding ⅛ in. in thickness and having a core ¼ in. in diameter; thus the drill had an outside diameter not exceeding ½ in. A hole slightly more than ½ in. deep was then sunk into the tire, preferably from the inside, using screw cutting oil or compound, and the core was broken off with a small wedge, and the end filed off until the face was just ½ in. from the surface of the tire. This small section ¼ in. diameter was then polished, etched and photographed. The ½-in. hole bored into the tire in the position indicated does not injure the tire for service, and consequently tests may be made quickly of any number of tires in a given shipment, in order to prove definitely whether or not the mill practice as to heat treatment has been satisfactory, and in accordance with specifications.

In drawing up specifications for the regulation of the heat treatment, it is simpler, it is thought, and far more satisfactory, to make an engraving from a photomicrograph at 50 diameters showing the maximum size of grain which will be accepted, printing this cut as part of the specifications. The small ½-in. test piece may also be used subsequently if so desired, in making the hardness test with the Seleroscope, provided a plane face is ground longitudinally on one side of the steel, using care to have this face exactly parallel with the opposite side at all points.

Fig. 4—90-lb. Rail, Center of Head, Coarse-Grained.

Fig. 5—Same Rail as Fig. 4, but Annealed.

Fig. 6—Locomotive Tire, Center (Carbon 0.53 Per Cent.)

In the suggestions which have been made above, we realize fully that this method of investigation does not indicate whether pipes, blowholes or similar defects are present, and reliance must be placed upon present methods of test and particularly of mill inspection to determine such quality. We are convinced, however, that if, in addition to soundness of steel and freedom from the grosser defects of manufacture, there is also present the fine granular form indicative of toughness, and with composition proportioned to insure a suitably high elastic limit, there will result not only increased safety of service, but also lessening of failures which now occur.

PROTECTIVE COATINGS.

Reports of progress were made by the committees having charge of the panels exposed on the Havre de Grace bridge of the Pennsylvania Railroad and the Atlantic City fence. While the observations have been made they have not yet been tabulated and analyzed, so that no definite statement can be made at present. There was also a further statement presented regarding the Westinghouse, Church, Kerr & Company paint tests. The tabulations, however, are averages taken by groups, so that it is impossible to tell what may have been the individual performance of any paint in a group. Announcement is also made of the immediate commencement of an elaborate white paint test at the Arlington, Va., experimental farm of the Department of Agriculture. The paint

Fig. 7—Same Tire as Fig. 6, but One-half Inch from Surface.

Fig. 8—Locomotive Tire, Center (Carbon 0.83 Per Cent.)

Fig. 9—Same Tire as Fig. 8, but One-half Inch from Surface.

is to be supplied by the various manufacturers, the panels are to be made by the Pennsylvania Railroad; the Baltimore & Ohio is to apply the paint; and the government is to provide the site.

THE SULPHURIC ACID CORROSION TEST.

There was a sharp discussion on the value of the sulphuric acid corrosion test as an indication of a metal's power to resist corrosion. According to the author of the paper on the subject, Cloyd M. Chapman, "a service test is the only certain method of demonstrating the true wearing qualities of the product, but a service test may require years to give the desired information," hence the demand for an accelerated test. He deprecated the sulphuric acid test as an unreliable indication of endurance in service, and cited two panels of iron and steel that had shown almost the same amount of pitting when exposed for eighteen months to the weather; while strips cut from the same plates showed a loss of iron of 6.7 per cent., and of steel of 83 per cent. when submerged for one hour in dilute sulphuric acid. He disclaimed any desire to be understood as claiming that the sulphuric acid test is useless, or that when properly used it may not give useful information, but he did wish to call attention to its utter inability to give a reliable indication of the relative ability of metals to withstand the corrosive action of the weather.

It was claimed by one member that the presence of copper in iron or steel had a very decided influence on the rate at which steel would go into an acid solution. Figures were presented in which the mere presence of copper seemed to drop the rate from more than 18 per cent. to about 0.43 per cent. As the analyses of the metals did not give the oxygen content, another member showed that while copper, as an alloy, might have a protective effect, as an impurity or mechanical mixture it might be the reverse of protective, and that the oxygen content was really the crucial point. He quoted case after case where the corrosion varied with the oxygen and that, therefore, it was quite as necessary to know the oxygen content as the copper.

DETECTION OF MINERAL AND RESIN OILS IN OTHER OILS.

A. E. Outerbridge, Jr., of the Wm. Sellers Company, made a demonstration of a method employed by that firm for the detection, quantitatively, of mineral or resin oil adulterations in linseed and other vegetable oils. It is based upon the fact that all of the mineral oils, except the gasolene distillates, show a bluish or greenish bloom when subjected to the light of an enclosed arc lamp. For purposes of comparison, he has a series of bottles containing the oil, say linseed, and adulterated with various percentages of mineral oil. In the linseed oil series, the first bottle contains pure linseed oil, the second 0.10 per cent. mineral oil, and the following, 0.20, 0.30, 0.40, 0.50, 1.00, 2.00, 5.00 10.00 and 20.00 per cent., respectively. These bottles of oil are set in a rack and exposed to the light of the lamp all displaying a fluorescence or bloom according to the quantity of contained adulterant. The sample to be tested is put in a bottle of the same size and run along beside the rack until its fluorescence corresponds with that of one of the bottles in the rack, when it will be found to contain the same amount of adulterant. Linseed oil has no bloom, and it has been found to be impossible to so remove the bloom from the mineral oils that they cannot be detected by this means.

PROPOSED REVISED STANDARD SPECIFICATIONS FOR LOCOMOTIVE CYLINDERS.

1. Locomotive cylinders shall be made from good quality close-grained gray iron, cast in a dry mold.

2. Drillings taken from test pieces as hereafter mentioned shall conform to the following limits in chemical composition:

Phosphorus	Not over 0.90 per cent.
Sulphur	Not over 0.10 per cent.

In case of rejection on this analysis, the manufacturer shall have the option of analyzing drillings from the bore of the cylinder, upon which analysis the acceptance or rejection of the cylinder shall be based.

At the option of the purchaser, two test bars, each 1¼ in. in diameter and about 14 in. long, may be cast for each cylinder. When placed horizontally upon supports 12 in. apart and tested under a centrally applied load, these test bars shall show an average transverse strength of not less than 3,000 lbs., and an average deflection not less than 0.09 in.

The above test pieces shall be cast on end in dry sand, the metal being taken from the ladle before pouring into the cylinder mold.

Before pouring, a sample of the iron shall be taken from the ladle and chilled in a cast-iron mold of the dimensions shown in Fig. 1. [Drawing not shown herewith. Dimensions: 5 in. x 2½ in. at top, and 4 in. x 1½ in. at bottom, x 2 in. deep. 90-deg. V, in bottom of mold, 1 in. wide.]

The sample shall be allowed to cool in the mold until it is dark red, or almost black, when it shall be knocked out and quenched in water. The sample, on being broken, must show a close-grained, well-mottled gray iron, with a well-defined border of white iron at the bottom of the fracture.

Castings shall be smooth, well cleaned, free from blow-holes, shrinkage cracks, or other defects sufficiently extensive to impair the value of the casting, and must finish to blue-print size.

Each cylinder shall have cast on each side of the saddle the manufacturer's mark, serial number, date made, and mark showing order number.

The inspector representing the purchaser shall have all reasonable facilities afforded to him by the manufacturer to satisfy himself that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of the manufacturer.

INSULATORS.

During the period from 1887 to about 1898, the Canadian Pacific Railway Company used white porcelain insulators on a portion of the long through wires. These were of German or British manufacture. An elaborate series of tests proved their great superiority over glass from a mechanical standpoint, the average blow necessary to break a porcelain being three times that required to break the glass insulator. It was also discovered that usually a porcelain insulator was only partially destroyed when hit by a stone and that the wire was not set free and remained fastened to each pole, but the glass insulator was so badly shattered that the wire would be freed and this frequently resulted in a cross with other wires which remained attached to the pole. This advantage was offset to some extent by the fact that, on account of the porcelain insulator being white, it offered a much better mark and was the one aimed at. The price of the porcelain insulator was increased until it reached about nine cents each laid down in Montreal, and its use by us, therefore, abandoned for some years. The glass insulator with which we were supplied then depreciated in quality, apparently on account of improper annealing, and appeals or complaints to the manufacturers resulted in no improvement; and, as the cost of the porcelain insulator was again very largely reduced, we have purchased nothing but white porcelain for the past three years.

Last year we procured porcelain insulators from Canada, the United States and Germany. One make turned out to have defective insulation properties, and we had a series of tests made comparing the three manufactures and glass. All of the insulators were of the same pattern and dimensions. One dozen insulators of each make, selected at random, were placed on pins in the open air, and frequent readings taken of insulation, humidity, temperature and barometer. During the tests the weather was of nearly every description, from dry cold to sleet, wet snow and rain. These tests proved that in every respect the German and United States insulators had from 5 to 10 times the insulating qualities of the Canadian and glass insulators, the two former giving practically the same results with a slight difference in favor of the German, and the Canadian porcelain and glass almost on a par. Tests of wires after erection show the same differences.—*W. J. Camp* (C. P. R.) before Railway Telegraph Superintendents.

LETTERS FROM AN OLD RAILWAY OFFICIAL TO HIS SON, A GENERAL MANAGER.*

SAN ANTONIO, TEXAS, May 20, 1911.

My Dear Boy: Let me tell you something about a wonderfully effective human machine, the Confederate Army. I sit facing a Confederate monument which depicts a self-reliant son of the Southland, the type of man real railway training helps to perpetuate. Hard by is a shrine to valor, the Alamo, a reminder of the duty of altruism which an individual owes to his fellows.

Fifty years ago two great armies were organized to fight to a practical, working conclusion some of the indefinite compromises of the Federal constitution. Each army was supported by the intelligent spirit of an aroused people. Each sought in its organization and operation to give the most effective expression to that spirit. Jefferson Davis and his advisers sought to profit by the experience of the old United States Army and to avoid inherent weaknesses in organization. So the Confederate Congress created the grades of general and of lieutenant general, in order that a general might command a separate field army, a lieutenant general a corps, a major general a division, and a brigadier general a brigade. By thus more exactly defining official status, jealousies were minimized. Until Grant was made lieutenant general in 1864, the Federal Army had only two grades of general officers, major general and brigadier general. This led to confusion, to bickerings, and to petty jealousies. Since a major general might command such distinct and self-contained units of organization as a division, a corps, or a separate field army, numerous special assignments by the President became necessary.

The Confederate Army had another feature of organization that was epoch making. Samuel Cooper had been adjutant general of the United States Army, with the rank of brigadier general, issuing orders over his own signature from Washington "by command of" somebody else, Brevet Lieutenant General Scott or the Secretary of War. Because of his acknowledged efficiency in office work and administrative routine, Samuel Cooper was made adjutant general and inspector general of the Confederate Army. Did they give him the rank of brigadier general? No, sir; they made him a full general, and number one on the list, senior to Albert Sidney Johnston, Robert E. Lee, Joseph E. Johnston and G. T. Beauregard, who, as generals at one time or another, commanded separate field armies or territorial military departments. General Cooper at a desk in Richmond was the ranking officer of the Confederate Army. This detracted not one iota from the fame of Lee, the great soldier and the first gentleman of the South. On the contrary the increased efficiency due to receiving instructions from a real superior, not under-strappers or chief clerks, made greater the reputation of Lee. From one viewpoint General Cooper was a high-class chief clerk for his President and Secretary of War. From a broader view he was their technically trained, highly efficient chief of staff.

The Confederate Army gave in effect, but not in name, the chief of staff idea to the world as a great object lesson in the applied science of organization. Historians say that Jefferson Davis, himself a graduate of West Point, a veteran of the Mexican war, and Secretary of War in the cabinet of Pierce, meddled too much in military affairs when as President he should have been attending also to civil affairs. Be that as it may, the organization was elastic enough to meet just such variations of personal equation. Whether the President, the Secretary of War or the adjutant general (chief of staff) acted in a particular case, the subordinate knew who took the responsibility and that the action came from a real superior in rank.

The Confederacy fell. The passions of the time, the shortsightedness of prejudice, precluded the adoption at that time by the United States of any feature of the Confederate organization, however meritorious in principle and practice. It remained for the Germans, already applying the idea, to dazzle the world in 1870 and conquer France by the work of their general staff and its able chief, von Moltke. Not until after the costly lessons of the little war with Spain in 1898 did our Congress wake up and give the United States Army a general staff and a chief of staff. The new law includes several desirable features of elasticity. Among these is a provision for the selection by each administration of its own chief of staff. A permanent chief of staff might be an obstruction or might become too perfunctory in compliance. The law wisely limits the selection of a chief of staff to about twenty general officers. This prevents playing untrained favorites. It permits any passenger conductor to be made superintendent, but forbids selecting an extra brakeman or the call boy. Furthermore, if conditions change or a new administration arrives, the chief of staff is not penalized for efficiency by losing out entirely but reverts to his permanent status; the superintendent holds his rights as a conductor and bids in a good run according to his permanent seniority. This feature of good organization, the conferring of definite local superior rank, and the protection of the incumbent from unnecessary degradation, was discovered centuries ago by another effective institution, the Catholic church.

Life is a composite. The army, like several railways, has been waking up to the fact that a lesson can be learned from the civil courts. A large city may have several courts and judges. A judge may sit for one term in the equity court, then in the criminal branch, and next in a court *en banc*. All the time there is only one office of record, one clerk of the court, with as many deputies as may be found necessary. When one judge wishes to know what another judge has done, the former does not write the latter a letter to inquire, but sends to the clerk's office and gets the complete record up to date.

Are the railways above copying sound working principles of efficiency from such tried institutions as the army, the navy, the civil courts and the churches? Certainly not, as some roads are showing in a highly practical way. Such movements as these are but expressions of a cosmic tendency, greater and more powerful than any one branch of human activity. Such trends of progress are noted by observers who happen to be favored with a view from the watch towers and who are able to make suitable adaptations because they realize that ideas are greater than men, that practical devices are greater than their inventors.

Sound ideas often depend for their development and permanency as working practices upon some great exponent of acknowledged capacity for leadership. In 1870 Bismarck had baited on the French and von Moltke had planned their discomfiture. In 1870 General Robert E. Lee, entering upon the last year of his life, was president of Washington and Lee University at Lexington, Virginia, where Colonel Allan, of Stonewall Jackson's staff, was a prominent professor. There came to sit at the feet of these great teachers a mere boy in years, but an adult in intellectual grasp. This callow youth was of German lineage but born and reared in New Orleans, a city stamped with the civilization of the French. Perhaps this modest youngster dreamed that twenty years later he would be a great railway engineer. Hardly, though that in forty years he would, as a great railway operating man, be called the von Moltke of transportation. Strange, indeed, that this von Moltke, Julius Kruttschnitt, should find his opportunity for highest development under the Napoleon of our profession, Edward H. Harriman, himself among the last of the feudal railway barons. Stranger still that as this Napoleon was passing his von Moltke was starting the railways away from feudalism in interior administration by introducing within the latter's own sphere the chief of staff idea of the Confederate, the German, and the American armies. For, my boy, the unit system of organization on the Harriman lines, of which you have read more or less, is primarily a substitution of the modern chief of staff idea for the outgrown, dwarfing, irrational government by chief clerks.

The unit system of organization requires that an official, whether the head of the unit or an assistant, shall, when absent on the line, be represented at headquarters by the senior or chief assistant of the unit. Such senior or chief assistant is in effect though not in name the chief of staff. Normally, this senior is number one on the list of assistants, but whoever is so acting becomes, as above explained, the senior for the time being, and

when relieved reverts to his permanent place on the list. Rotation for this chief of staff depends largely on the personal equation of the head of the unit and of his various assistants. In the last two years some divisions have not rotated the chief of staff at all. One superintendent who credits the system with increased supervision and notable decreases in expenses is now rotating his assistants in the senior chair every two weeks.

There are diverse views on the subject of rotation in general. My own opinion is that it may or may not be desirable. I incline rather to rotation because it seems to be a biological concomitant of rational evolution. Nature rotates her seasons and her types. Where, as in the tropics, there is less rotation we find more stagnation and quicker death. Many soils are impoverished by neglect of proper crop rotation. The other day in a terminal, I found a superintendent lately rotated, like a Methodist minister, from another division. Favored with a fresh viewpoint, he was having switch engines give trains a start out of the yard, and was taking off a helper engine which for years had seemed an unavoidable expense. For what was in this particular instance a case of over-specialization he was substituting engines which could more economically perform the dual functions of switching and of pushing.

Speaking of yards, see if you have not some bright fellows on your staff who can figure out a car record that can be taken by the mechanical men, the car inspectors, that will answer all the purposes of transportation, including claims. Instead of two sets of specialists, car inspectors and yard clerks, partly duplicating each other' work, see if you cannot develop one set of all 'round men with some interchangeability of function. No, you cannot do it all at once. Even if you have a workable scheme it will take a long time to establish. The Brown system of discipline required nearly twenty years for its complete extension to practically all American railways, although in successful operation for nearly a hundred years at the United States Military Academy at West Point. The demerit system is better handled at West Point than is the Brown system on railways. This is because most of the officers are relatively better trained than railway officials, having all been through the mill themselves. Better training cultivates the judicial quality. Too often the number of Brownies does not depend upon a fixed scale for a like offense, but rather upon how mad the superintendent is or on how hard he has been pounded by the typewriter in the offices above.

Before you condemn any system be certain that its apparent shortcomings are not the fault of your own interpretation and administration. We used to speak of engine failures alone. Nowadays we distinguish as between engine failures and man failures. Likewise there is a difference between a system failure and a man failure.

Affectionately your own, D. A. D.

Kotaro Tanaka, a director and the manager of the Japan Rolling Stock Company (Mihon Sharyo Kwaisha), in an article on the future of the rolling-stock industry in Japan, contributed to the journal, *Industrial Japan,* of May 1, says that the amount of rolling stock which will be required in the near future as a result of the expansion of Japanese railways will be very large. He says he knows it to be a fact that the estimated amount of new rolling stock to be placed on the government lines in Japan between 1910 and 1923 consists of more than 500 locomotives, 750 passenger cars, and 9,300 freight cars, to cost about $13,450,000. This amount will be needed prior to the completion of the broad-gage line between Tokyo and Shimonoseki, probably to be commenced next year, while almost twice as much will likely be required after its opening sometime around 1925. Mr. Tanaka says that with the enlarged demand for rolling stock domestic manufacturers will be stimulated to increase their output. He urges that they should endeavor to prevent the necessity for the further importation of foreign railway supplies, but this will evidently be impossible and foreign manufacturers will doubtless secure a good share of the orders for the new rolling stock, especially locomotives.

TRANSPORTATION AND CAR ACCOUNTING OFFICERS.

The summer meeting of the Association of Transportation and Car Accounting Officers was held at Cape May, N. J., June 20-21, with 122 members in attendance, and President M. B. Casey in the chair. At the opening Tuesday morning, the association was favored with an address by Theodore Voorhees, vice-president of the Philadelphia & Reading, extracts from which are given elsewhere.

The report of the Executive Committee indicates a membership operating 244,383 miles and having in service 2,438,510 cars. Twenty-four roads were admitted to membership during the past six months. It was decided to hold the next meeting at Louisville, Ky., December 12 and 13.

The association adopted the recommendation of the Committee on Car Service with regard to proposed revision of Rule 10, Code of Car Service Rules, for submission to the American Railway Association; the committee accepting on the floor a slight change in the wording of the proposed form of rule. The proposed rule as it will be submitted to the American Railway Association, with request that it be eliminated from the Code of Car Service Rules and included in the Code of Per Diem Rules, as a new rule, is as follows:

> (a) When any freight car is detained by reason of a railway error *or omission and demurrage cannot legally be assessed, this fact to be certified to by the demurrage manager or official in charge of demurrage under the organization in effect on each road,* the erring road shall pay to the holding road the rate established by the Per Diem Rules for freight cars, *provided the holding road notifies the road originating the shipment, as shown by the billing, by wire within five days from date of arrival of shipment at billed destination, or point at which car is held, that delivery cannot be effected.*
>
> (b) *Failure on part of holding road to notify originating road within five days that car is being held will make reclaim eligible only from date of notice and five days in addition thereto.*
>
> (c) *If it develops that error was made by an intermediate road the holding road will take up by wire with the first connection of the originating road, or with the road at fault, within three days after receipt of advice that originating road is not responsible for the error.*
>
> (d) *Claims under this rule must be made and sent to the erring road within twelve months from the first day of the month succeeding that in which the car is received.*

In connection with the remarks of Vice-President W. L. Park, of the Illinois Central, at the last meeting of the association, with regard to misuse of cars, the committee presented a recommendation which was adopted by the association for submission to the American Railway Association. The recommendation is as follows:

> "Inasmuch as serious objection has been raised from an accounting point of view to the application of an arbitrary penalty for each diversion, your Committee would recommend that provision be made in the Per Diem Rules Agreement, that in the event of habitual failure to observe these rules, the offending road be "cited" to defend its action before the Executive Committee of the American Railway Association, and, further, that the Executive Committee of the American Railway Association be empowered to fine the offending road in accordance with the magnitude of the offense. The amount of fine imposed to be based upon the injury sustained by the complainant road, plus the cost of the proceedings before the American Railway Association."

The Committee on Office Methods and Accounting reported that 185 private car owners have adopted the reporting marks assigned by the committee, and are applying the same to their cars. The plan of the committee in this connection contemplates a separate and distinctive assignment of marks for each private line of cars for the purpose of preventing confusion in identifying ownership. The assignment of these marks by the committee of this association is by authority of the American Railway Association. The recommendation of the committee with regard to entering the records of delivery of foreign cars to connections from junction reports after they have been prepared from the current interchange reports was adopted as the recommended practice of the association. The reiteration of the com-

mittee in connection with the receiving road retaining the best carbon copies of interchange reports, the delivering road accepting the original or hard copy and one carbon copy, was concurred in. The form presented for transmitting per diem claims was adopted as the recommended form of the association. Acting under instructions of the association at its last meeting, the committee reported that it had conferred with the per diem rules arbitration committee of the American Railway Association and had suggested an explanatory foot note relating to Interpretation No. 34, in connection with which a letter was subsequently received from the chairman of the per diem rules arbitration committee advising, "that in view of the general situation, an adherence to Interpretation No. 34 is necessary to preserve the intent of per diem Rule 11 and do substantial justice."

The report of the Committee on Conducting Freight Transportation containing proposed uniform practice for the preparation of statistics showing the average cost of handling cars through a terminal yard was returned to the committee for further consideration.

The Committee on Conducting Passenger Transportation presented an interpretation of Rule 7, Code of Car Service Rules, as it relates to wrongful diversion of passenger and baggage cars, and proposed an addition to the rule as follows:

(C) Should a passenger equipment car be appropriated, without consent to the owner or joint service; and in addition thereto the established the road responsible shall pay to the owner the established Per Diem Rate under Rule 7 (B) from the hour of appropriation until hour car is returned to the owner or joint service; and in addition thereto the established mileage rate under Rule 7 (A) shall be paid owner by each road using car.

This proposed addition will be submitted to the American Railway Association.

In connection with the subject of manner of payment for the service of cars damaged while in joint service, the committee presented a resolution, which was adopted for submission to the American Railway Association, viz.:

Resolved, That under Rule 7, Code of Car Service Rules, when a foreign passenger equipment car received in joint service is damaged, necessitating its movement to and from shops, the mileage due under Section A of such rule shall be paid for the distance that car was used in the joint service, and, that under Section B of such rule, the owner shall be paid the Per Diem Rate during the period that the car is out of service. When a car is detained awaiting the receipt of repair material from its owner, the Per Diem shall cease from the date the necessary material is ordered from the owner until the date when it is received by the road holding the car.

An interesting report was presented by the Committee on Joint Interchange and Inspection Bureaus, which advised that at its meeting held jointly with representatives of the committee from the Master Car Builders' Association a letter was drafted for presentation to the General Superintendents' Association of Chicago, recommending the permanent establishment of the Joint Car Inspection and Interchange Bureau at the Union Stock Yards, Chicago, which was then being experimentally conducted; also commending the consideration by the General Superintendents' Association of the question of modification of the agreement under which cars are now interchanged throughout the Chicago switching district, with a view to a strict observance of M. C. B. rules and the application of M. C. B. defect cards, and assuring that association of the committee's co-operation to that end. The bureau at the Union Stock Yards has been made permanent.

The following officers were elected for the ensuing year: President, G. W. Taylor (Sou. Ry.); First Vice-president, W. T. Wolff (Pa. Lines); Second Vice-president, J. M. Daly (Ill. Cent.); Secretary, G. P. Conard, New York; Treasurer, F. M. Luce (formerly C. & N. W.).

After the close of the business session on Wednesday, a banquet was given in honor of H. G. Sleight, who retires this year from the Executive Committee, because of retirement from the service of the Vandalia on account of the age limit. Mr. Sleight is the father of the association, the original association having been formed in the year 1876, pursuant to a suggestion which he made to several friends among the superintendents of transportation and car accountants who were in office at that time.

SOME HISTORY WITH NAMES OMITTED.*

The diversity of interest between the car borrowers and the car owners has always led to the fixing of the per diem rate at less than an equitable return to the car owner. With the fluctuations in traffic and the occasional considerable surplusage of equipment, such as exists at the present time, the roads have again and again endeavored to open the question of per diem rates and seek relief from their proper payments. This is no new condition. We have all heard the same story and have known of cases where roads have endeavored to suppress proper acknowledgment of amounts due to foreign roads for car service.

I remember a case a good many years ago where I became satisfied from an analysis of the traffic and the returns, that a particular road, through its car accounting officers, was cutting mileage due us to a very considerable extent each month. I found that our cars in through traffic on the road in question were reported as averaging about four miles a day each. Knowing the principal executive officer of the company quite well, and, in my innocence, believing that he could not possibly appreciate what was being done by his subordinates, I laid the matter before him. In reply, he said: "This is about the hundredth letter that I have had in regard to this very same thing. I have been through it with our people, and if they cut the mileage they have done it on their own account and have covered it up. In looking up this matter, however, we have found some extraordinary things in the reports of mileage of other roads to our company, and I shall be very glad if the time ever comes when we get a per diem."

Now, gentlemen, that may have been "smart," but I doubt whether such "smartness" pays in the long run. It was not many years after, that one of the principal railway officers in that territory was an embezzler of his company's funds to a very large amount. It is an easy step from cheating in behalf of your employer to cheating the employer himself.

Old tricks of cutting mileage or suppressing reports wholesale have been pretty nearly done away with by the adoption of the per diem plan. There remain, however, the questions of errors and discrepancies in reports, which are only brought to light by inquiry. Apparently a good many people think that it is all right to forget to make reports, and only acknowledge amounts due after claim is made and pressure brought to bear. One of my sons, when a little chap, was obliged by his mother to wear shoes without heels. Day after day he would come down to breakfast wearing his elder brother's shoes which had heels, and invariably his mother would send him upstairs to put his own shoes on. One morning a lady visiting us, said to him: "Gerald, why do you keep coming down with your brother's shoes, when you know that your mother will not allow you to wear them, and you simply have to go upstairs to take them off?" "Well," he said, "Aunt Nellie, some day she will forget!"

No doubt this is actually due in many cases to want of sufficient force in the car accountants' offices. I think it is a great mistake for a road to economize in that department in the way of clerical force. It is equally a mistake to compromise or jump at a conclusion in regard to a balance. Either per diem charges are right or they are wrong, and they should be settled accordingly in exact amounts.

We have for many years past collected, as a result of great painstaking, sums that were due the company but which would otherwise have been lost through carelessness—considerably in excess of the cost of the clerical force and correspondence necessary to secure the same. In the past eight years, the Philadelphia & Reading has secured from other roads, as a result of claims, more than 4 per cent. of the total amount of its car service balances, while we have paid out to other roads on like account only one-third of 1 per cent.

*From an address by Theodore Voorhees, vice-president, Philadelphia & Reading, before the Association of Transportation and Accounting Officers, at Cape May, N. J., June 20.

RAILWAY TELEGRAPH SUPERINTENDENTS.

The Association of Railway Telegraph Superintendents held its annual convention at Boston, June 26-30, with a large attendance. First Vice-president J. B. Sheldon presided, President I. T. Tyer being detained at home by ill-health. The secretary's report showed 169 members in good standing.

The first paper read was that of W. J. Camp (C. P.), extracts from which will be found in other columns. In the discussion of this paper it appeared that on some roads the efficiency of porcelain insulators is seriously interfered with by cobwebs, as well as in some degree by deposits of smoke. Mr. Johnson, of the Pennsylvania, said that on his road wires are paired for telegraph working, as well as for telephone.

Mr. Chetwood (W. U. Tel.) said that the double-petticoat porcelain insulator is about four times as good as glass, but final conclusions are yet to be established. Signs of aging of porcelain are apparent. A new type of double-petticoat glass insulator has been designed and tests indicate about 75 per cent. better insulation than former types, besides being less fragile. At this time a porcelain insulator does not appear generally justified for telegraph lines, except for exceptionally long haul service. A porcelain insulator to be of any value must be absolutely non-absorbent.

On the second day brief speeches were made by Belvidere Brooks, general manager of the Western Union, and other officers of that company. The first paper was one by W. P. Cline, on Co-operation Between Railway People and Commercial Telegraph Companies. A paper on telephone transmission was read by J. L. McQuarrie.

A report from the committee on high tension wire crossings was presented by G. A. Cellar (Pa. Lines). This report was approved and the committee continued. The large telegraph and telephone companies will be invited to co-operate in the work of this committee.

E. P. Griffith (Erie) reported that the fund for the erection of a monument at Turner, N. Y., commemorating the first telegraphic train order, had been brought up to $1,116; and he read a letter from Mrs. E. H. Harriman, offering to meet the whole expense of providing the monument, which announcement was greeted with applause. Mrs. George S. Minot, a niece of Charles Minot, superintendent of the Erie Railroad, who sent that first telegraph order, was present at the meeting. Mrs. Minot lives in Brookline, Mass., near Boston.

F. F. Fowle, of Chicago, read a paper on line conductors for telegraph transmission, demonstrating the effect of leakage by artificial circuits set up in the meeting rooms.

G. K. Heyer, of the Western Electric Company, read a paper on telephone economy in railway service. Mr. Heyer finds that some railways estimate the loss due to the stoppage of traffic on their main lines by a wreck at $1,000 an hour, from which it will be seen that the use of the telephone in decreasing delays on such occasions, as compared with telegraph working, must be a definite money saver. W. F. Williams, of the Seaboard Air Lines, has found that in a single month on 150 miles of his line, single track, the average running time of through freight trains was by telephone operation reduced 1 hour and 16 minutes, as compared with 1908; and passenger and other trains also received decided benefit. Mr. Heyer thinks that the Seaboard Air Line thus saved $1,000 a month, showing that the telephone apparatus paid for itself the first year. Telephones are now in use on about 48,000 miles of railway line in this country, so that if the saving effected on the Seaboard Air Line is repeated everywhere, the benefit derived from the telephones amounts to a large sum. The Delaware Lackawanna & Western also reports a marked saving in the time of through freight trains since the adoption of the telephone.

On Wednesday the first paper read was one by John B. Adams on telephone cable transmission. Mr. Adams set forth the rules for calculating the capacity of telephone lines, putting his ideas in non-technical language.

W. E. Harkness, of New York, read a paper on current supply for selective calling systems, comparing the cost of different combinations of apparatus; and W. Maver, Jr., of New York, read a paper on high speed automatic perforators and perforator receivers. A paper by William Bennett, of Chicago, on economy in the telegraph department, was read by W. F. Williams. U. J. Fry (C., M. & St. P.), described the telephone circuits which he has in use for train despatching between Mobridge, S D., and Seattle, Wash., 1,376 miles. These circuits are worked duplex regularly. There is one repeating station between Butte and Seattle.

The following officers were elected for the ensuing year: President, G. A. Cellar (Penn. Lines), Pittsburgh; first vice-president, William Bennett (C. & N. W.); second vice-president, A. B. Taylor (New York Central); secretary and treasurer, P. W. Drew (M., St. P. & S. S. M.), Chicago.

The forenoon of Tuesday was devoted to sightseeing. In the evening a trip was made to Revere Beach. On Thursday a party of members went to Plymouth to see the place where the Pilgrims landed, spending the entire day.

EXHIBITS.

American Typewriter Telegraph Co., New York; the Cardwell printing telegraph.

J. H. Bunnell & Company, New York; Ramsey cable jack or quick switch.

General Railway Signal Co., Rochester, N. Y.; selector apparatus for telephone lines.

Holtzer-Cabot Electric Co., Brookline, Mass.; tubular wire connectors.

National Telephone Selector Company, New York; new alternating-current open-circuit telephone selector system for train despatching; also a selector for message circuits.

Randall Telephone Mfg. Co., New York; Randall telephone train despatching outfit, with loud speaking telephone receiver.

United States Electric Company, New York; Gill selector apparatus for railway telephone lines; train order semaphore, designed to be controlled by the despatcher; selectors having both the two-figure and four-figure combination; a new selector with two time-wheels, with which a call can be made in three seconds. This company also exhibited a large variety of other specialties.

Western Electric Co., New York and Chicago; loud speaking receiver for telephone lines; rotophone transmitter arm; new master selector; and a great variety of telephone apparatus and accessories.

THE LOETSCHBERG TUNNEL.

The following notes on the completion of the Loetschberg tunnel, in Switzerland, are taken from the *Moniteur Industrielle*. An illustrated description of the work was published in the *Railway Age Gazette* of July 2, 1909.

On March 31 the two headings of the Loetschberg tunnel between Kandersteg and the Loetsch valley came together. But the formal opening of the line is not expected until 1913.

Work was begun in the latter part of 1906, so that something less than five years has been required for the penetration of about 47,675 ft. of rock from north to south. No enterprise of this kind has ever approached this rapidity of execution before, and it is quite proper to consider this as establishing a world's record.

The work is French in conception and execution. According to the first estimates and surveys, the tunnel was to have had a length of 45,050 ft. with a single track; and it was upon this basis that the work was begun. At the start the pick was used, but with this primitive method years on years would have passed before it would have been completed. On March 1, 1907, an electric system with means of mechanical drilling was installed; and thanks to a Swiss subvention, it became possible so to enlarge the tunnel that a double track could be laid.

It was the electric installation, the first to be set up at the work, that made the completion a possibility, and the results obtained at the Loetschberg show that mountain tunneling has been robbed of most of its difficulties. Here an excavation of 1,000,000 cu. yds. of rock was required and an advance at the rate of 130 cu. yds. a week was regularly effected.

At the north end the electric current was furnished by the hydraulic works at Spiez, at 15,000 volts as a three-phase alternating current. At the south end a similar current was furnished by the works at Lonza with which it was possible to supply power to the several secondary work shops. Electricity was not, however, used as a motive power in the heading. All drilling and all underground traction was done with air that had been compressed by electricity.

COMPARATIVE SUMMARY OF FREIGHT CARS IN SERVICE ON RAILWAYS OF THE UNITED STATES—1900 AND 1910.

NOTE.—Narrow gage cars excluded. Non-revenue cars excluded. Company freight included.

	Miles.		Freight Equipment.				Percent of change.	Freight cars per mile of road.		Average length of haul.		Freight Cars. Per 1,000 Frt. car miles.		Freight Cars. Per 1,000 rev. ton miles.		Rate per ton mile (dollars).		Frt. cars per $1,000 Frt. earnings.	
	1900.	1910.	1900.	1910.	Increase.	Decrease.		1900.	1910.	1900.	1910.	1900.	1910.	1900.	1910.	1900.	1910.	1900.	1910.
New England Roads:																			
Boston & Maine R. R.	1,787	2,290	12,230	24,747	12,517	.....	102.35	6.8	10.8	66.99	102.84	.126	.115	.0146	.0105	.01440	.01085	1.02	0.97
Bangor & Aroostook R. R.	354	599	3,091	5,356	2,265	.....	73.30	8.7	8.9	89.62	118.58	....	.316	.6539	.0280	.01420	.01153	3.79	2.43
Central Vermont R. R.	513	536	2,006	2,489	483	.....	24.10	3.9	4.6	94.97	79.27	.063	.086	.0079	.0085	.00880	.00910	1.09	0.94
Maine Central R. R.	816	932	3,586	7,030	3,444	.....	96.04	4.4	7.5	81.11	88.90	.163	.152	.0123	.0125	.01130	.00980	1.09	1.29
New York, New Haven & Hartford R. R.	2,008	2,042	13,116	35,716	22,600	.....	172.31	6.5	17.5	85.36	93.44	.076	.170	.0097	.0168	.01451	.01417	0.67	1.19
Total	5,478	6,399	34,029	75,338	41,309	.....	121.39	6.5	11,8	83.61	96.61	.107	.168	.0197	.0133	.01264	.01109	1.49	1.36
Trunk Line Roads:																			
Baltimore & Ohio R. R.	3,179	4,434	61,708	83,693	21,985	.....	35.62	19.3	18.9	194.81	191.48	.128	.105	.0068	.0069	.00412	.00577	1.96	1.21
Buffalo, Roch. & Pittsburgh R. R.	472	567	8,858	16,232	7,374	.....	83.25	18.7	28.5	136.16	154.60	.139	.205	.0097	.0106	.00470	.00481	1.99	2.15
Central R. R. Co. of New Jersey	639	631	15,002	21,958	6,956	.....	46.37	23.4	34.8	77.88	72.39	.153	.172	.0118	.0103	.00871	.00846	1.36	1.21
Chesapeake & Ohio R. R.	1,476	1,937	17,270	37,453	20,183	.....	11.69	21.6	19.3	302.00	267.00	.082	.116	.0058	.0061	.00343	.00407	1.71	1.50
Delaware & Hudson Co.	665	843	13,030	20,659	7,629	.....	58.71	19.6	24.5	94.46	129.21	.147	.141	.0113	.0078	.00789	.00680	1.54	1.24
Delaware, Lack. & Western R. R.	947	957	27,287	28,284	997	.....	3.65	28.8	29.5	151.00	170.00	....	.111	.0144	.0081	.00808	.00766	1.79	1.07
Erie Railroad	2,104	2,227	46,225	48,294	2,069	.....	4.48	21.9	21.7	191.40	165.48	.101	.112	.0089	.0075	.00559	.01599	1.60	1.26
Lehigh Valley R. R.	1,382	1,433	34,954	43,752	8,798	.....	25.17	25.3	30.5	188.08	164.01	.135	.146	.0106	.0089	.00542	.00646	1.97	1.43
N. Y. C. & H. R. R. R.	2,817	3,785	59.180	71,131	11,951	.....	20.19	21.1	18.3	163.00	192.19	....	.089	.0088	.0067	.00560	.00630	1.72	1.22
Pennsylvania R. R.	3,716	4,045	80,385	137,981	57,596	.....	71.65	21.6	34.1	109.54	156.17	.091	.120	.0067	.0064	.00540	.00583	1.25	1.17
Reading R. R.	1,000	998	31,824	40,971	9,147	.....	28.74	31.8	41.0	89.42	92.93	.139	.137	.0114	.0084	.00831	.00727	1.50	1.16
Western Maryland R. R.	279	543	691	6,949	6,258	.....	905.64	2.5	12.8	51.02	105.66	....	.119	.0038	.0072	.00734	.00612	.053	1.17
Total	18,696	22,400	396,414	557,357	160,943	.....	40.60	21.2	24.9	145.73	155.09	.093	.131	.0092	.0079	.00622	.00713	1.56	1.32
Southern Classification:																			
Atlantic Coast Line Ry.	1,759	4,491	5,378	24,322	18,944	.....	352.25	3.6	5.4	121.90	146.15	....	.167	.0143	.0148	.01401	.01273	1.02	1.17
Central of Georgia R. R.	1,196	1,916	5,041	10,095	5,054	.....	100.26	4.2	5.3	148.86	149.69	.107	.138	.0183	.0111	.01096	.01069	1.26	1.27
Louisville & Nashville R. R.	3,007	4,591	23,402	43,019	19,617	.....	83.82	7.7	9.4	163.00	164.21	.096	.118	.0090	.0086	.00758	.00751	1.13	1.12
Mobile & Ohio R. R.	876	1,114	5,389	10,682	5,293	.....	98,22	6.2	9.6	195.63	169.36	....	.104	.0076	.0075	.00590	.00600	1.33	1.37
Nashville, Chat. & St. Louis R. R.	1,189	1,230	5,328	9,557	4,229	.....	79.37	4.4	7.8	151.00	219.34	.113	.355	.0096	.0113	.00880	.00990	1.10	1.14
Norfolk & Western R. R.	1,551	1,937	18,656	38,025	19,369	.....	103.80	12.0	19.6	253.41	148.00	.085	.103	.0068	.0057	.03430	.00447	1.58	1.27
Seaboard Air Line Ry. (1901)	2,604	2,997	8,335	14,712	6,377	.....	76.51	3.2	4.9	153.32	264.53	.119	.118	.0136	.0120	.01180	.01133	1.14	1.06
Southern Railway	6,306	7,050	26,814	49,092	22,278	.....	83.08	4.2	7.0	168.82	150.64	.107	.130	.0116	.0099	.00916	.00957	1.27	1.29
Total	18,488	25,326	98,343	199,504	101,161	.....	102.90	5.3	8.4	169.49	175.29	.105	.154	.0114	.0101	.00906	.00902	1.23	1.28
Central Classification:																			
Chicago, Ind. & Louisville R. R.	546	616	5,440	5,895	455	.....	8.36	9.9	9.6	153.00	149.00	.155	.163	.0141	.0112	.00757	.00773	1.86	1.45
Cincinnati, Hamilton & Dayton Ry.	652	1,036	7,838	11,881	4,043	.....	51.58	12.0	11.5	108.96	127.93	....	.159	.0122	.0090	.00610	.00529	2.00	1.76
C. C. C. & St. L. R. R.	1,891	1,982	15,484	24,477	8,993	.....	58.07	8.2	12.3	169,30	151.80	.094	.092	.0083	.0063	.00583	.00546	1.42	1.23
Grand Rapids & Indiana R. R.	582	587	3,015	3,228	213	.....	7.06	5.2	5.5	90.12	105.37	.140	.089	.0156	.0068	.00870	.00657	1.88	1.04
Lake Erie & Western R. R.	725	886	5,549	3,922	.....	1,627	29.32	7.6	4.4	153.51	128.34	.137	.079	.0110	.0056	.00614	.00656	1.89	0.90
Lake Shore & Mich. Southern Ry.	1,411	1,663	19,958	50,497	30,539	.....	153.02	14.1	30 4	178.00	158.70	.057	.118	.0055	.0076	.00505	.00523	1.09	1.55
Michigan Central R. R.	1,635	1,803	14.219	24,673	10.454	.....	73.52	8.6	13.7	193.50	152.00	....	.094	.0070	.0076	.00592	.00629	1.19	1.28
N. Y., Chicago & St. Louis R. R.	513	523	6,743	13,098	6,355	.....	94.24	13.1	25.0	297.00	203.00	.059	.091	.0055	.0069	.00478	.00504	1.16	1.41
Pennsylvania Company	1,396	1,416	43,967	56,444	12,477	.....	28.38	31.5	39.8	77.95	80.02	.177	.132	.0135	.0077	.00590	.00583	2.30	1.35
P. C. C. & St. L. R. R.	1,407	1,468	12,884	24,508	11,624	.....	90.22	9.1	16.7	111.14	117.93	.056	.072	.0052	.0053	.00620	.00614	0.84	0.87
Pere Marquette R. R.	1,821	2,328	7,944	18,433	10,489	.....	132,03	4.3	7.9	112.64	179.03	....	.125	.0124	.0091	.00802	.00591	1.55	1.65
Vandalia R. R.	727	827	5,922	8,832	2,910	.....	49.14	8.1	10.7	74.46	105.86	.121	.107	.0119	.0076	.00718	.00611	1.66	1.25
Total	13,306	15,135	148.963	245,888	96,925	.....	65.07	11.2	14.4	143.63	138.25	.112	.110	.0102	.0076	.00645	.00601	1.57	1.31
Western Classification:																			
Atchison, Topeka & Santa Fe Ry.	7,426	9,961	27,486	54,419	26,933	.....	97.99	3.7	5.5	349.19	360.59	.073	.079	.0079	.0059	.00976	.01015	0.81	0.76
Chicago & Alton R. R.	855	998	9,386	11,884	2,498	.....	26.61	10.9	11.9	176.16	150.82	.135	.117	.0148	.0079	.00794	.00598	1.87	0.46
Chicago & Eastern Illinois R. R.	711	966	8,206	18,892	10,686	.....	130.22	11.5	19.5	144.70	155.81	.132	.177	.0096	.0091	.00483	.00460	1.99	2.04
Chicago & Northwestern R. R.	5,219	7,629	40,846	62,685	21,839	.....	53.47	7.8	8.2	151.30	141.40	.108	.175	.0106	.0113	.00830	.00890	1.28	1.26
Chicago, Burl. & Quincy R. R.	7,546	9,040	42,287	49,881	7,594	.....	17.96	5.6	5.5	254.87	266.80	....	.080	.0111	.0067	.00851	.00783	1.29	0.86
Chicago, Great Western Ry.	930	1,495	5,782	11,772	5,990	.....	103.59	6.2	7.9	301.68	239.69	.087	.113	.0081	.0098	.00720	.00716	1.13	1.38
Chicago, Mil. & St. Paul R. R.	6,423	7,297	35,740	43,415	7,675	.....	21.47	5.6	5.9	189.07	173.52	.093	.091	.0106	.0070	.00929	.00843	1.14	0.97
Chicago, Rock Island & Pacific R. R.	3,647	8.044	17,150	40,380	23,230	.....	135.45	4.7	5.0	213.00	209.55	.094	.095	.0096	.0077	.00990	.00920	1.08	0.96
Chicago, St. P., Minn. & Omaha R. R.	1,557	1.739	10,253	11,606	1,353	.....	13.20	6.6	6.7	160.55	148.10	.149	.173	.0135	.0108	.00971	.00908	1.39	1.19
Colorado & Southern R. R.	762	2,062	2,979	9,666	6,687	.....	224.47	3.9	4.7	101.00	149.00	.108	.106	.0115	.0070	.01242	.00964	0.93	0.80
Denver & Rio Grande R. R.	1,674	5,541	8,359	14.850	6,491	.....	77.65	4.9	5.3	.....	104.51	.118	.145	.....	.0096	.....	.01280	1.09	0.86
Duluth, S. S. & Atlantic R. R.	585	606	2,697	3,056	359	.....	13.31	4.6	5.0	49.07	67.51	....	....	.0209	.0122	.01221	.00857	1.70	1.43
Great Northern Ry.	5,418	7,147	21,484	44,283	22,799	.....	106.12	3.9	6.2	192.00	244.51	.104	.111	.0085	.0067	.00899	.00822	0.93	0.95
Illinois Central R. R.	3,996	4,551	32,439	59,330	26,891	.....	82.90	8.1	13.0	213.83	238.48	.092	.113	.0094	.0076	.00651	.00589	1.45	1.53
Iowa Central R. R.	510	558	2,238	3,561	1,323	.....	59.11	4.4	6.4	152.30	166.67	.099	.121	.0084	.0074	.00696	.00588	1.21	1.34
Kansas City Southern Ry.	833	827	5,118	6,536	1,418	.....	27.70	6.1	7.9	304.41	240.01	.118	.090	.0091	.0059	.00613	.00725	1.49	0.90
Minn. & St. Louis R. R.	597	1,027	3,066	4,385	1,319	.....	42.72	5.1	4.3	108.79	108.95	.196	.184	.0155	.0123	.01212	.01050	1.45	1.39
*Minn., St. Paul & S. Ste. Marie R. R.	1,255	3,533	6,631	21,453	14,822	.....	223.69	5.3	6.1	194.65	215.88	.129	.123	.0109	.0090	.00658	.00722	1.67	1.23
Missouri Pacific Ry.	4,938	6,775	25,186	37,958	12,772	.....	50.71	5.1	5.4	236.24	217.90	.102	.100	.0095	.0068	.00834	.00688	1.15	0.99
Missouri, Kansas & Texas Ry.	2,218	3,072	9,669	22,497	12,828	.....	132.77	4.4	7.3	298.93	193.05	.073	.118	.0082	.0113	.00840	.01050	0.98	1.32
Northern Pacific R. R.	5,006	5,814	23,138	43,816	20,678	.....	89.37	4.6	7.5	309.60	296.60	.105	.117	.0104	.0066	.00987	.00900	1.04	0.88
St. Louis & San Francisco R. R.	†1,659	5,072	5,974	27,899	21,925	.....	36.70	3.6	5.5	182.05	155.66	.093	.119	.0114	.0082	.01058	.00980	1.08	1.09
St. Louis Southwestern Ry.	1,258	1,473	5,386	9,268	3,882	.....	72.08	4.3	6.3	196.28	260.12	.127	.136	.0130	.0116	.01110	.01040	1.17	1.12
San Antonio & Aransas Pass R. R.	687	724	1,553	2,023	470	.....	30.26	2.3	2.8	162.26	155.82	.113	.092	.0142	.0111	.01861	.01500	0.95	0.74
Southern Pacific Company	7,576	10,077	29,413	44,254	14,841	.....	50.46	3.9	4.4	307.31	243.42	.096	.082	.0062	.0056	.00957	.01162	0.73	0.57
Texas & Pacific R. R.	1,570	1,885	6,263	10,983	4,720	.....	75.36	3.9	5.8	231.77	184.00	.079	.097	.0093	.0099	.01030	.01010	0.91	0.98
Union Pacific R. R.	5,428	6,996	21.826	25,618	3,792	.....	17.37	4.0	4.1	305.68	345.78	.080	.060	.0082	.0035	.01046	.01024	0.78	0.42
Wabash R. R.	2,340	2,515	13,087	21,536	8,449	.....	64.55	5.6	8.6	216.70	219.56	.071	.079	.0068	.0061	.00558	.00585	1.23	1.11
Total	82,624	113,724	423,642	717,906	294,264	.....	69.46	5.0	6.3	211.25	201.98	.104	.114	.0106	.0084	.00926	.00881	1.21	1.09
TOTAL, ALL ROADS	138,592	182,984	1,101,391	1,795,993	694.602	.....	63.07	8.0	9.9	172.89	176.35	.105	.128	.0112	.0089	.00835	.00811	1.37	1.22

*1910 figures include Wisconsin Central R. R. † Before consolidation with other companies.

COMPARATIVE SUMMARY OF FREIGHT CARS IN SERVICE ON RAILWAYS OF THE UNITED STATES—1909 AND 1910.

NOTE.—Narrow gage cars excluded.
Non-revenue cars excluded.
Company freight included.

	Miles.		Freight Equipment.				Percent of change.	Freight cars per mile of road.		Average length of haul.		Freight Cars. Per 1,000 Frt. car miles.		Freight Cars. Per 1,000 rev. ton miles.		Rate per ton mile (dollars).		Frt. cars per $1,000 Frt. earnings.	
	1909.	1910.	1909.	1910.	Increase.	Decrease.		1909.	1910.	1909.	1910.	1909.	1910.	1909.	1910.	1909.	1910.	1909.	1910.
New England Roads:																			
Boston & Maine R. R.	2,289	2,290	24,859	24,747	.....	112	0.45	10.8	10.8	104.09	102.84	.121	.115	.0117	.0105	.01083	.01085	1.08	0.97
Bangor & Aroostook R. R.	515	599	5,360	5,356	.....	4	0.01	10.4	8.9	123.91	118.58	.305	.316	.0295	.0280	.01170	.01153	2.51	2.43
Central Vermont R. R.	536	536	2,730	2,489	.....	241	8.89	5.1	4.6	89.23	79.27	.102	.086	.0093	.0085	.00840	.00910	1.12	0.94
Maine Central R. R.	932	932	7,109	7,030	.....	79	1.11	7.6	7.5	88.80	88.90	.157	.152	.0141	.0126	.00995	.00980	1.42	1.29
New York, New Haven & Hartford R. R.	2,044	2,042	34,184	35,716	1,532	.....	4.48	16.7	17.5	93.77	93.44	.174	.170	.0182	.0168	.01420	.01417	1.29	1.19
Total	6,316	6,399	74,242	75,338	1,096	.....	1.34	11.6	11.8	99.96	96.61	.172	.168	.0165	.0133	.01130	.01109	1.49	1.36
Trunk Line Roads:																			
Baltimore & Ohio R. R.	4,004	3,434	80,759	83,693	2,934	.....	3.63	20.1	18.9	192.25	191.48	.119	.105	.0087	.0069	.00581	.00577	1.50	1.21
Buffalo, Roch. & Pittsburgh R. R.	568	567	15,199	16,232	1,033	.....	6.79	26.8	28.5	155.40	154.60	.238	.205	.0122	.0106	.00482	.00481	2.52	2.15
Central R. R. Co. of New Jersey	610	631	20,181	21,958	1,777	.....	8.80	33.1	34.8	75.28	72.39	.164	.172	.0102	.0103	.00839	.00846	1.22	1.21
Chesapeake & Ohio R. R.	1,897	1,937	34,182	37,453	3,271	.....	9.57	18.0	19.3	275.00	267.00	.122	.116	.0067	.0061	.00410	.00407	1.64	1.50
Delaware & Hudson Co.	843	843	21,152	20,659	.....	493	2.33	25.0	24.5	134.20	129.21	.144	.141	.0088	.0078	.00670	.00680	1.33	1.24
Delaware, Lack. & Western R. R.	957	957	27,541	28,284	743	.....	2.69	28.8	29.5	172.00	170.00	....	.111	.0083	.0081	.00781	.00766	1.06	1.07
Erie Railroad	2,231	2,227	50,941	48,294	.....	2,647	5.20	22.8	21.7	183.21	165.48	.124	.112	.0085	.0075	.00586	.01599	1.48	1.26
Lehigh Valley R. R.	1,441	1,433	41,970	43,752	1,782	.....	4.24	29.1	30.5	167.71	164.01	.145	.146	.0092	.0089	.00639	.00646	1.49	1.43
N. Y. C. & H. R. R. R.	3,782	3,785	64,846	71,131	6,285	.....	7.69	17.2	18.3	193.26	192.19	.083	.089	.0066	.0067	.00631	.00630	1.19	1.22
Pennsylvania R. R.	4,015	4,045	128,220	137,981	9,761	.....	7.61	31.9	34.1	158.68	156.17	.113	.120	.0066	.0064	.00580	.00583	1.16	1.17
Reading R. R.	997	998	42,204	40,971	.....	1,233	2.92	42.3	41.0	94.23	92.93	.154	.137	.0102	.0084	.00759	.00727	1.36	1.16
Western Maryland R. R.	543	543	6,444	6,949	505	.....	7.84	11.9	12.8	108.24	105.66	.140	.119	.0082	.0072	.00620	.00612	1.32	1.17
Total	21,888	22,400	533,639	557,357	23,718	.....	4.44	24.4	24.9	159.12	155.09	.141	.131	.0087	.0079	.00632	.00713	1.44	1.32
Southern Classification:																			
Atlantic Coast Line Ry.	4,476	4,491	24,255	24,322	67	.....	0.27	5.4	5.4	142.09	146.15	.134	.167	.0167	.0148	.01259	.01273	1.32	1.17
Central of Georgia R. R.	1,916	1,916	10,269	10.095	.....	174	1.69	5.4	5.3	151.14	149.69	.152	.138	.0123	.0111	.01079	.01069	1.38	1.27
Florida East Coast Ry.	585	583	998	1,150	152	.....	15.20	1.7	2.0	160.95	164.21	....	.065	.0114	.0121	.01951	.02006	.058	0.60
Louisville & Nashville R. R.	4,398	4,591	41,720	43,019	1,299	.....	3.11	9.5	9.4	174.40	169.36	.130	.118	.0098	.0086	.00763	.00751	1.28	1.12
Mobile & Ohio R. R.	1,114	1,114	11,066	10,682	.....	384	3.47	9.9	9.6	220.00	219.34	.113	.104	.0096	.0075	.00621	.00600	1.55	1.37
Nashville, Chat. & St. Louis R. R.	1,230	1,230	9,458	9,557	99	.....	1.05	7.7	7.8	156.00	148.00	.266	.355	.0115	.0113	.00960	.00990	1.20	1.14
Norfolk & Western R. R.	1,903	1,937	35,529	38,025	2,496	.....	7.02	18.6	19.6	268.19	264.53	.111	.103	.0066	.0057	.00460	.00447	1.43	1.27
Seaboard Air Line Ry.	2,603	2,997	13,966	14,712	746	.....	5.34	5.4	4.9	154.41	150.64	.136	.118	.0138	.0120	.01129	.01133	1.23	1.06
Southern Railway	7,170	7,050	51,741	49,092	.....	2,649	5.12	7.2	7.0	169.73	164.65	.143	.130	.0116	.0099	.00952	.00957	1.51	1.29
Total	25,395	25,909	199,002	200,654	1,652	.....	0.83	7.8	7.7	177.43	174.06	.148	.144	.0115	.0103	.00908	.01025	1.27	1.14
Central Classification:																			
Chicago, Ind. & Louisville R. R.	616	616	5,999	5,895	.....	104	1.73	9.7	9.6	143.00	149.00	.176	.163	.0142	.0112	.00825	.00773	1.72	1.45
Cincinnati, Hamilton & Dayton Ry.	1,036	1,036	12,528	11,881	.....	647	5.16	12.0	11.5	124.13	127.93	.190	.159	.0125	.0090	.00529	.00529	2.28	1.76
C. C. C. & St. L. R. R.	1,982	1,982	22,123	24,477	2,354	.....	10.63	11.7	12.3	152.70	151.80	.089	.092	.0064	.0063	.00544	.00546	1.33	1.23
Grand Rapids & Indiana R. R.	587	587	3,226	3,228	2	.....	0.06	5.5	5.5	104.95	105.37	.095	.089	.0072	.0068	.00666	.00657	1.08	1.04
Lake Erie & Western R. R.	886	886	4,237	3,922	.....	315	7.43	4.8	4.4	123.54	128.34	.096	.079	.0069	.0056	.00686	.00656	1.07	0.90
Lake Shore & Mich. Southern Ry.	1,663	1,663	34,231	50,497	16,266	.....	38.75	20.6	30.4	163.00	158.70	.082	.118	.0057	.0076	.00518	.00523	1.15	1.55
Michigan Central R. R.	1,746	1,803	18,249	24,673	6,424	.....	35.20	10.5	13.7	162.00	152.00	.072	.094	.0060	.0076	.00626	.00629	1.00	1.28
N. Y., Chicago & St. Louis R. R.	523	523	11,716	13,098	1,382	.....	11.79	22.4	25.0	205.00	203.00	.087	.091	.0071	.0069	.00516	.00504	1.42	1.41
Pennsylvania Company	1,416	1,416	53,163	56,444	3,281	.....	6.17	37.5	39.8	77.26	80.02	.149	.132	.0086	.0077	.00595	.00583	1.45	1.35
P. C. C. & St. L. R. R.	1,469	1,468	23,008	24,508	1,500	.....	6.52	15.7	16.7	117.39	117.93	.077	.072	.0060	.0053	.00641	.00614	0.93	0.87
Pere Marquette R. R.	2,285	2,328	18,641	18,433	.....	208	1.11	8.6	7.9	180.44	179.03	.137	.125	.0109	.0091	.00577	.00591	2.02	1.65
Vandalia R. R.	827	827	7,849	8,832	983	.....	12.52	9.4	10.7	101.17	105.86	.110	.107	.0088	.0076	.00669	.00611	1.32	1.25
Total	15,036	15,135	214,970	245,888	30,918	.....	14.38	14.4	14.4	137.88	138.25	.113	.110	.0084	.0076	.00649	.00601	1.39	1.31
Western Classification:																			
Atchison, Topeka & Santa Fe Ry.	9,793	9,961	51,445	54,419	2,974	.....	5.89	5.3	5.5	363.53	360.59	.087	.079	.0067	.0059	.01026	.01015	0.80	0.76
Chicago & Alton R. R.	998	998	12,067	11,884	.....	183	1.51	12.1	11.9	151.28	150.82	.117	.117	.0082	.0079	.00570	.00598	1.58	1.46
Chicago & Eastern Illinois R. R.	966	966	18,925	18,892	.....	33	0.17	19.6	19.5	159.41	155.81	.199	.177	.0108	.0091	.00480	.00460	2.36	2.04
Chicago & Northwestern R. R.	7,638	7,629	58,453	62,685	4,232	.....	7.24	7.3	8.2	148.31	141.40	.175	.175	.0120	.0113	.00900	.00890	1.34	1.26
Chicago, Burl. & Quincy R. R.	9,279	9,040	51,741	49,881	.....	1,860	5.29	5.6	5.5	239.74	266.80	.093	.080	.0066	.0067	.00790	.00783	.098	0.86
Chicago Great Western Ry.	1,476	1,495	10,649	11,772	1,123	.....	10.54	7.2	7.9	235.32	239.69	.112	.113	.0086	.0098	.00688	.00716	1.43	1.38
Chicago, Mil. & St. Paul R. R.	7,297	7,297	43,692	43,415	.....	277	0.63	5.0	5.9	183.69	173.52	.091	.091	.0074	.0070	.00838	.00843	1.03	0.97
Chicago, Rock Isl. & Pacific R. R.	8,026	8,044	37,448	40,380	2,932	.....	7.83	4.7	5.0	212.76	209.55	.098	.095	.0079	.0077	.00940	.00920	0.96	0.96
Chicago, St. P., Minn. & Omaha R. R.	1,739	1,739	12,430	11,606	.....	824	6.62	7.1	6.7	144.77	148.10	.204	.173	.0130	.0108	.00903	.00908	1.44	1.19
Colorado & Southern R. R.	1,980	2,062	8,649	9,666	1,017	.....	11.76	4.4	4.7	138.00	149.00	.114	.106	.0077	.0070	.01067	.00964	0.82	0.80
Denver & Rio Grande R. R.	2,534	2,541	11,668	14,850	3,182	.....	27.27	4.6	5.8	108.38	104.51	.126	.145	.0086	.0096	.01310	.01280	0.76	0.86
Duluth, S. S. & Atlantic R. R.	594	606	2,804	3,056	252	.....	8.98	4.7	5.0	67.23	67.51	....	....	.0163	.0122	.00951	.00857	1.72	1.43
Great Northern Ry.	6,878	7,147	42,280	44,283	2,003	.....	4.73	6.1	6.2	267.55	244.51	.129	.111	.0074	.0067	.00910	.00822	1.07	0.95
Illinois Central R. R.	4,551	4,551	60,113	59,330	.....	783	1.30	13.2	13.0	242.91	238.48	.128	.113	.0083	.0076	.00596	.00589	1.67	1.53
Iowa Central R. R.	558	558	3,418	3,561	143	.....	4.18	6.1	6.4	162.71	166.57	.130	.121	.0085	.0074	.00616	.00588	1.45	1.34
Kansas City Southern Ry.	827	827	6,908	6,536	.....	372	5.38	8.3	7.9	261.29	240.01	.110	.090	.0071	.0059	.00749	.00725	1.04	0.90
Minn. & St. Louis R. R.	1,027	1,027	4,386	4,385	.....	1	0.02	4.3	4.3	102.84	108.95	.206	.184	.0152	.0123	.01075	.01050	1.57	1.39
*Minn., St. P. & S. Ste. Marie R. R.	2,395	3,533	12,624	21,453	8,829	.....	69.94	5.3	6.1	234.18	215.88	.146	.123	.0116	.0090	.00793	.00722	1.46	1.23
Missouri Pacific Ry.	6,489	6,775	39,044	37,958	.....	1,086	2.78	6.0	5.4	214.13	217.90	.113	.100	.0083	.0068	.00704	.00688	1.18	0.99
Missouri, Kansas & Texas Ry.	3,072	3,072	22,031	22,497	466	.....	2.11	7.2	7.3	219.94	193.05	.131	.118	.0136	.0113	.01042	.01050	1.31	1.32
Northern Pacific R. R.	5,733	5,814	41,498	43,816	2,318	.....	5.58	7.2	7.5	313.10	296.60	.114	.117	.0066	.0066	.00895	.00900	0.86	0.88
St. Louis & San Francisco R. R.	5,251	5,072	26,677	27,899	1,222	.....	4.58	5.1	5.5	150.29	155.66	.125	.119	.0090	.0082	.01010	.00980	1.04	1.09
St. Louis Southwestern Ry.	1,470	1,473	9,109	9,268	159	.....	0.17	6.2	6.3	243.22	260.12	.139	.136	.0127	.0116	.01080	.01040	1.18	1.12
San Antonio & Aransas Pass R. R.	724	724	2,150	2,023	.....	127	5.90	3.0	2.8	159.36	155.82	.104	.092	.0111	.0111	.01513	.01500	0.80	0.74
Southern Pacific Ry.	9,977	10,077	43,444	44,254	810	.....	1.87	4.4	4.4	256.52	243.42	.089	.082	.0060	.0056	.01154	.01162	0.62	0.57
Texas & Pacific R. R.	1,885	1,885	10,917	10,983	66	.....	0.60	5.8	5.8	185.00	184.00	.103	.097	.0108	.0099	.01030	.01010	1.07	0.98
Union Pacific R. R.	6,062	6,296	26,025	25,618	.....	407	1.55	4.3	4.1	383.70	345.78	.065	.060	.0041	.0035	.00845	.01024	0.48	0.42
Wabash R. R.	2,515	2,515	22,910	21,536	.....	1,374	5.99	9.1	8.6	219.11	219.56	.088	.079	.0073	.0061	.00582	.00585	1.33	1.11
Total	111,734	113,724	693,505	717,906	24,401	.....	3.52	6.2	6.3	206.79	201.92	.123	.114	.0090	.0084	.00887	.00881	1.19	1.09
TOTAL, ALL ROADS	180,369	183,567	1,715,358	1,797,143	81,785	.....	4.77	9.0	9.8	177.08	176.20	.127	.125	.0095	.0089	.00809	.00837	1.31	1.20

*1910 figures include Wisconsin Central R. R.

Shop Section.

FOR six months we have been publishing articles on scientific management, and as a climax we invited the efficiency engineers to tell us how to apply it to a railway shop. The results appear in this issue. It seems only fair that our readers should also be allowed to have their say. What practical results have you gained from all this discussion and editorial criticism? Has it done you any good at all? Have you applied it in any way, direct or indirect? Have you evolved or developed any practical schemes for improved efficiency during the past six months whether inspired by the articles on efficiency or not. We realize that you are busy and that it is hard to get the time or energy to write an article during the hot weather. Therefore we invite you to write a short, chatty letter to the editor, telling of your experience or ideas along the above lines. You need not make hard work of this. It wouldn't be hard work to write your brother or your best friend a newsy letter of this sort. Just imagine the editor as your best friend—he is just as anxious to hear from you, and will be just as pleased as your best friend would be. Make the letter just long enough to clearly tell your story, and do not worry about the rhetoric or spelling. For those letters which are accepted for publication we will pay our regular space rates. A minimum rate of $3 is paid for all articles which are used. The letters must be received on or before Thursday, July 27.

ANOTHER general shop kink competition will close September 15. Kinks of any kind used in the repair or maintenance of locomotives, cars or other mechanical department equipment will be eligible. Do not make the descriptions so meager that the judges and editor will have to use their imaginations to fill in the details. Remember that the design of the piece which the kink is used on may be peculiar to your own road or shop and hardly be intelligible to outsiders. We have been asked to make our descriptions more extended. We can do it, if you will help us. Just a word as to the illustrations. All that is necessary is that they clearly show the design of the kink so that its construction and working may be clearly understood. Blueprints, sketches or photographs may be used, or all three. A prize of $50 will be awarded for the best collection of three kinks, and a prize of $25 for the next best collection. More than three kinks may be submitted, allowing the judges to base their decision on the best three in each collection. Kinks not awarded a prize, but accepted for publication, will be paid for at our regular space rates.

H. H. VAUGHAN, assistant to the vice-president of the Canadian Pacific; G. W. Wildin, mechanical superintendent of the New York, New Haven & Hartford, and T. S. Lloyd, superintendent motive power and equipment of the Delaware, Lackawanna & Western, the judges in the competition on "How Scientific Management Can be Applied to a Railway Shop," which closed June 15, have rendered the following decision: "None of the articles submitted are properly discussions of the subject—The Application of Scientific Management to a Railway Shop. They are directed more to questions of organization, or of the merits and meaning of scientific management in a general sense. After carefully reviewing them we have decided that those possessing the greatest general interest and merit are Nos. 5 and 4 in the order named." No. 5 was submitted by Max H. C. Brombacher, practical production or efficiency engineer, 94 West 183 street, New York, and No. 4 by L. W. Allison, Los Angeles, Cal. There were three other contestants, C. J. Morrison, manager of the department of effective organization, Suffern & Son, New York; J. S. Sheafe, engineer of tests, Illinois Central, Chicago, and H. F. Stimpson, chief engineer, Universal Audit Company of New York.

JULY 15 marks the close of the competition on reclaiming scrap material. No competition that we have yet announced offers such an attractive field for good articles. The range covered by it is so broad that there is not one of our Shop Section readers but should be in position to enter the competition. For the past few years the attention of mechanical department employes has been focused on the question of economical and efficient operation. The study of the scrap pile has offered a fruitful source of economies, which have resulted in cutting down the expenditures for new material. Some have made savings in one way, others in another. Our idea is to make the result of this competition a sort of clearing house for all the good things that have been accomplished along these lines. More complete announcements will be found in the April, May and June Shop Sections. The best article will be awarded a prize of $35, and the second best a prize of $20. Articles accepted for publication, but not awarded a prize will be paid for at our regular space rates.

IN reading the essays on the application of scientific management to a railway shop let us cast aside all prejudice which we may have against the efficiency engineers and let us study their articles with an open mind, for they represent the results which have been reached by men of more or less practical experience, who have spent much time and energy in studying the problem of efficiency. We may disagree with them in many things, but if we are big enough and broad enough we must surely find some inspiration or some suggestions which we can put to practical use in the plans which they have so courteously submitted.

MR. BROMBACHER, in his essay on the application of scientific management to railway shops, which was awarded the first prize in the competition on that subject, emphasizes the value and importance of "really intelligent piece work." In an article on Comparing the Efficiency of Railway Shops, in the *Railway Age Gazette* of June 2, he also directed attention to this fact, and cited the Delaware, Lackawanna & Western as having an ideal piece work system. Undoubtedly piece work has been and is being abused, but we believe that in the majority of cases it is now being properly directed in railway shops. If it is not properly or fairly administered the workmen will be the first to find it out, with a resulting decrease in efficiency of the plant. Fortunately, most railway managers have awakened to the fact that the "square deal" and "maximum efficiency" are terms which go hand in hand and cannot be separated. Le Grand Parish, one of the best mechanical department organizers and managers, and who was more than ordinarily successful in introducing piece work, said, when he was still a master car builder on the Lake Shore: "The first law of piece work is honesty, and departure from this law should meet with instant dismissal from the service. This applies to foremen as well as workmen." Mr. Brombacher makes some good, general suggestions concerning the method of introduction and the administering of piece work. We congratulate him upon being awarded the first prize.

THE Old Railroader's article on the Instruction of Apprentices and Handy Men struck a discordant note in the articles which were submitted in the competition on the instruction of workmen and apprentices, which closed two or three months ago. The other papers were chiefly concerned with advanced methods of apprenticeship and were written largely by men in an atmosphere favorable to the best development of apprentices. There are still many shops, however, where the old order of things exists—where little attention is paid to the

apprentice or his welfare and where he has to shift largely for himself. He is tolerated as a sort of necessary evil—the busy foremen desire to be troubled with him as little as possible, except to make sure that the company loses nothing by his presence. The Old Railroader has stated the case frankly and plainly, and such roads or shops as are guilty of handling the apprentices in this way are to be pitied, for after all the railways need good apprentices much worse than the young men or apprentices need the railway shops. Fortunately the number of shops where this is not realized is growing smaller rapidly, and even the car department, which, except for a few isolated cases, has hardly known the meaning of the word apprentice, is beginning to wake up.

THE provision of transfer tables and overhead cranes for handling locomotives, always a serious problem, even in the larger shops, and far more so in the smaller ones where it is only necessary to provide a few pits in the erecting shop, has been solved in the new shop plant of the New York, Philadelphia & Norfolk, by leaving them out entirely. As shown by the drawings on another page the five tracks leading to the pits in the erecting shop radiate from the turntable, which also serves the six stalls on the engine house. Just how the shop would be modified should it become necessary to double the number of erecting pits does not appear. The most logical solution would seem to be to extend the engine house and use the portion of it nearest the erecting shop for erecting purposes. Possibly the conditions at Cape Charles are such that the present shop will take care of all future requirements; at least the location of the blacksmith shop, preventing any possibility of an extension of the erecting shop on that side of the machine shop would seem to indicate this.

LE ROY ALLISON, the winner of the second prize in the competition on How Scientific Management can be Applied to the Railway Shop, has given us a splendid essay on common sense—and it is the man with a goodly supply of this rather scarce commodity that will make the most of the recent discussions of efficiency and scientific management. He will be the first one to look inward and examine himself and his methods to see if they can be improved by putting into practical effect any of the ideas or theories which have been so voluminously advanced by the efficiency engineers. And there is not the slightest doubt but that some of them can be so applied in the average railway shop. Their value, however, will never be fully demonstrated unless they are administered by the practical man with plenty of common sense. Handled by the theorist, in a mechanical manner, as the engineer applies a formula which he finds in an engineer's handbook, they are sure to fall flat.

AS a general rule it is well to select young men as apprentice instructors; not that the older men cannot make a big success of the job, if they are properly adapted to it, but because it is so much easier for the younger men, who are just a few years out of their time, to understand the feelings of the apprentice and to see things from his viewpoint. There has been such a wonderful development in railway shop practice and equipment in the last 10 or 15 years, and the conditions and environment of the workmen have so changed that it is exceedingly difficult for one who has been trained under the older conditions to realize how the apprentice of today looks upon his work and his surroundings. With this thought in mind the article by E. B. Ralph on the Education and Development of Apprentices, which appears on another page, is of more than ordinary interest. Mr. Ralph is an apprentice instructor on the Santa Fe at Fort Madison, Iowa, and served his time at that shop just before the new apprentice system was introduced a few years ago. While readers of the Shop Section are familiar with the details of the apprentice work as carried on on the Santa Fe, Mr. Ralph's description of the work from his viewpoint is well worth reading.

IN a most interesting series of articles, entitled The Autobiography of a Jailer, which has been appearing in *The Saturday Evening Post,* we find this statement: "To paraphrase Lincoln, a house of correction can't stand with the prisoners all sober and the guards all under the influence of liquor." By treating the prisoners decently and giving them a square deal their behavior and deportment improved wonderfully and they were encouraged to lead better lives, instead of being coarsened and losing all their self-respect, as was the natural result under the opposite methods of treatment. We do not, of course, want to put mechanics and apprentices in the same class with prisoners, nevertheless human nature is the same in the home, the shop, the church, or the jail. In order to prove effective in developing and uplifting the apprentices, those in charge of them must be men whom the boys will look up to. Every boy or young man—and the older ones too—has some man or men that he admires and whose example he is quite likely to follow. The apprentice instructors, coming in intimate contact with the boys, are the men to whom they will be naturally attracted and whose every move they will watch closely. It is, therefore, absolutely necessary for the best interests of the railway and the community that these men be most carefully selected, and that although their ability as mechanics and instructors should be an important factor in their selection, that their morals and personal magnetism and probable influence on the boys be given the most careful consideration—all of which is suggested by reading the lines and between the lines of the article on The Making of Good Mechanics, which was prepared by D. C. Davis, an apprentice instructor on the Santa Fe.

LIKE a cool refreshing breeze on a hot sweltering July afternoon comes the statement in C. J. Morrison's article on the Application of Scientific Management to a Railway Shop that: "The workmen will be of great assistance in this (improving the condition of tools and machines and designing labor-saving devices) if suggestions are encouraged and the co-operation of the men secured. In commercial enterprises it has been found profitable to pay for useful suggestions. There is every reason to believe that this policy would pay on a railway." And again, "In all cases harmonious working must be striven for, the organization must be constructive, and everyone in the shop must be *encouraged to think.*" The doctrines of one or two of the leading efficiency engineers have emphasized the necessity of having a planning department to direct all the operations performed by the workman. As one editor aptly expressed it this planning department is expected to have a monopoly of all the brains in the workshop. Another efficiency engineer took a workman to task for making a suggestion because, as he said, "you are paid for doing the work and I am paid for doing the thinking." If we are going to smother all the initiative on the part of the workmen, where are our future leaders to come from? Where would the efficiency of our railway shops be today if this policy had been pursued in the past. Of course, Mr. Morrison's suggestion is a good one, but it is not original with the efficiency engineers. Practical shop managers, and in railway shops at that, have realized its importance for many years. The reference to the sweltering July afternoon did not refer to the rest of Mr. Morrison's article, which on the whole is a very good one, but to the above-mentioned attitude of some of the less practical efficiency engineers toward the workman and his efforts.

MR. STIMPSON, in his article on the application of scientific management to a railway shop, rightly emphasizes the fact that the greatest efficiency can only be obtained when the movement has the support of the entire organization from

the board of directors down. This should not discourage those in direct charge of the shops from doing their best and of trying to show the higher officers where their policies may seriously effect the efficiency of the repair shops. Mr. Stimpson's idea that the loss of efficiency between the directing power in an organization and the workers, or rank and file, may be compared to the loss in energy between the coal pile and the various agents through which its energy is transmitted until it actually performs the work in a machine, is a happy one. Just how we may get the same efficiency from a large organization as was formerly obtained by a master with three or four or more men working directly under him is a serious problem and one that will not easily be solved. The type of management must be such as to eliminate as much lost motion as possible by having the workers understand exactly what is wanted and giving them the facilities for doing it. But more than this, and what promises to be more difficult to bring about, the workers must have a keen realization that their welfare is dependent upon that of their employer. The employer on the other hand must do his full part in bringing the workmen to realize that he is interested in their welfare. No form of management or no method of paying wages can accomplish this in itself. The spirit which dominates an ideal organization of this type is not the product of school or college, nor of any system of management. It is developed by real leaders—like Topsy, "they just grow." Nevertheless, if they have the natural talent they can do much to develop and cultivate it by the observation and study of principles which have helped others to gain successful results.

SUMMER CONVENTIONS.

FIVE conventions, all of more or less interest to Shop Section readers, will meet during July, August and September. These include, in the order of their meeting, the American Railway Tool Foremen's Association at the Wellington Hotel, Chicago, July 11-13; the International Railway General Foremen's Association at the Hotel Sherman, Chicago, July 25-27; the International Railroad Master Blacksmiths' Association at the Boody House, Toledo, Ohio, August 15-17; The Traveling Engineers at the New Hotel Sherman, Chicago, August 29-September 1; and the Master Car and Locomotive Painters' Association at Atlantic City, N. J., September 12-15.

The American Railway Tool Foremen's Association is the youngest of these associations, having only been organized in December, 1909. The attendance at the meeting last year, considering that it was only the second meeting, was good and the members discussed the different subjects thoroughly and to the point. A campaign for new members has been carried on during the year and the prospects are for a well-attended meeting. Among the subjects to be reported upon and discussed are the following: The making of dies for forging machines; the economical use and care of emery wheels; equipment of railway tool rooms; special appliances for use with pneumatic tools; standardizing tools; and the co-operation of the shop foremen and tool room foremen in the care and maintenance of small tools. The president of the association is M. H. Bray, tool room foreman of the New York, New Haven & Hartford at New Haven, Conn.; the secretary is O. T. Harroun, tool room foreman of the Chicago & Alton at Bloomington, Ill.

The International Railway General Foremen's Association was organized in 1905. It had a splendid meeting at Cincinnati last year and the indications for the coming convention are that it will be a record breaker. In the first place the executive committee has arranged for the discussion of thoroughly practical questions of vital interest to shop and engine house foremen, and in the second place a most aggressive campaign has been made for new members during the past year. The meeting was quite well attended at Cincinnati last year, but the secretary has been canvassing the situation and expects an attendance at least three times as large this year. The executive committee, feeling that better results can be obtained by the thorough discussion of a few important questions, has assigned only four subjects for committee reports. These are: How can shop foremen best promote efficiency; shop kinks; methods of shop organization; and axle wheel fits. The committee on shop kinks has secured the co-operation of the *Railway Age Gazette* in the publication of a book on Railway Shop Kinks, an extended announcement of which will be found under New Books. The president of the association is C. H. Voges, general foreman of the Cleveland, Cincinnati, Chicago & St. Louis at Bellefontaine, Ohio; the secretary is Luther H. Bryan, general foreman, Duluth & Iron Range, Two Harbors, Minn.

The International Railroad Master Blacksmiths' Association's next convention will be the nineteenth in its history. It is a strong, thoroughly organized association and has a splendid record behind it. There is no lost motion in the work of the convention. A good blacksmith is always thoughtful and thorough, and this characteristic predominates in the work of the association. There is also a certain individuality about its meetings that differs entirely from that of the other foremen's associations. Among the subjects for consideration this year are the following: Tools and formers; drop forging; flue welding; frogs and crossings; high speed steel; locomotive frame making and repairs; oxy-acetylene process for welding and cutting metals; case hardening; and piece work and other methods. The president is John Connors, master blacksmith of the Atlanta & West Point at Montgomery, Ala.; the secretary is A. L. Woodworth, of the Cincinnati, Hamilton & Dayton at Lima, Ohio.

The Traveling Engineers' Association, like the Master Blacksmiths', is about to hold its nineteenth meeting. Like the former association it has a splendid organization and next to the Master Mechanics' and Master Car Builders' Associations is probably the most important and influential mechanical department organization. The attendance, always large, will undoubtedly be much greater this year, because of the place of meeting, Chicago. Because the attendance will be so large it is extremely advisable that special precautions be taken this year to secure a room for the meeting having good acoustic properties and as far removed from the noises of the street, or kitchen, as possible. The entire second floor of the new Hotel Sherman, where the meeting is to be held, will be used for exhibits, about 8,000 sq. ft. of space being available. The subjects to be reported on this year are: Advantages of the brick arch; increased efficiency of locomotives and the advantages of treated water; actual demonstration vs. oral instruction in air brake operation; lubrication of high pressure and superheated locomotives; efficient handling of electric locomotives; developments and improvements in locomotive stokers; revision of progressive examinations for firemen and new men for promotion; and the Mallet compound in road service. The president is F. C. Thayer, general road foreman of engines, Southern Railway, Atlanta, Ga.; the secretary is W. O. Thompson, master car builder, New York Central & Hudson River, East Buffalo, N. Y.

The Master Car and Locomotive Painters' Association is almost as old as the Master Car Builders' Association, which recently held its forty-fifth convention, and the Master Mechanics' Association, which held its forty-fourth convention in June. The next convention of the Master Painters' will be the forty-second meeting. The association has a large membership list and accomplishes its work thoroughly and with dispatch. Undoubtedly a large part of the progress which has been made in the painting of railway rolling stock can be directly traceable to the work of this association. J. H. Pitard, master car painter of the Mobile & Ohio at Whistler, Ala., is president, and A. P. Dane of the Boston & Maine, Boston, Mass., is secretary.

It is noteworthy that three of the five presidents of the above associations are located in the far south—John Connors at Montgomery, Ala.; F. C. Thayer at Atlanta, Ga., and J. H. Pitard at Whistler, Ala.

MECHANICAL ARTICLES DURING JUNE

THE following articles of special interest to mechanical department readers, and to which Shop Number readers may wish to refer, have appeared in the weekly issues since that of June 2:

Maintenance of Equipment Costs. By C. J. Morrison. Maintenance of equipment ranks second among the items entering into railway operating expense. Mr. Morrison's studies of the comparative costs of repairs and renewals to locomotives, maintenance of freight and passenger cars, and maintenance of shop machinery and tools on different roads is thoroughly illustrated by a large number of diagrams and charts. He suggests that a better unit than the cost per locomotive or the cost per locomotive-mile by which to compare the cost of repairs and renewals to locomotives would be a work unit calculated by multiplying the tractive effort in pounds by the average mileage per locomotive and dividing by 1,000,000. June 9, page 1303.

Controlling Modern Passenger Trains. Abstract of a paper presented before the Air Brake Association by Walter V. Turner. Ordinary passenger brake equipment is not equal to the demands of modern service and heavy equipment. Diagrams are presented showing the advantages of the improved passenger brake equipment for this service as compared with the ordinary passenger brake equipment. June 9, page 1316.

Turbine Locomotives. An editorial commenting on the application of the steam turbine to locomotives and drawing attention to a small locomotive so equipped at Milan, Italy. June 16, page 1399.

Rigid vs. Non-Rigid Freight Trucks. A communication showing how the truck journal box and its contained parts are distorted when the truck is forced out of square. June 16, page 1400.

Forty-Foot Refrigerator Car. Illustrated description of a car built by the Union Fibre Company. It is equipped with a collapsible ice tank, a non-splash drip pan, a specially heavy insulation and a Leeds ventilator, all of which are illustrated. June 16, page 1404.

Mikado and Pacific Type Locomotives; Baltimore & Ohio. The 40 Mikados and the 10 Pacific type locomotives recently built for this road are the heaviest of their types thus far built by the builders, the Baldwin Locomotive Works. June 16, page 1411.

Fuel Economy on the Chicago & Alton. The new Mikado locomotives equipped with superheaters are far more efficient, from the standpoint of fuel economy, than the non-superheater consolidation locomotives formerly used for the same service. The article presents data derived from the monthly performance sheets. June 16, page 1414.

Breaking-in-Two of Freight Trains. Abstract of the discussion on this subject at the recent meeting of the Air Brake Association. June 16, page 1414.

57½-Ton Steel Hopper Car; Norfolk & Western. A description of a type of all-steel hopper car which has been developed on the Norfolk & Western for the coal carrying traffic. June 23, page 1656.

NEW BOOKS.

Locomotive Breakdowns. By George L. Fowler, M.E.; enlarged and revised by Wm. W. Wood. Published by the Norman W. Henley Publishing Co., New York. 276 pages, 99 illustrations; 4½ in. x 6½ in. Price, $1.

This volume is a catechism treating on accidents and breakdowns of locomotives on the road and how to repair them. It is written in the question and answer form, containing over 500 practical questions. In this, the seventh edition, the breakdowns have been revised to include features of the more modern locomotives and the air-brake chapter has been enlarged. Information has also been added concerning the Walschaert and Baker-Pilliod valve gears. The book is intended especially for enginemen and roundhouse mechanics, but contains information for all interested in locomotive repairs.

Railway Shop Kinks. By Roy V. Wright, Mechanical Department Editor of the *Railway Age Gazette*, under the supervision of a committee of the International Railway General Foremen's Association consisting of H. D. Kelley, chairman, C. H. Voges and L. H. Bryan. 300 pages, 803 illustrations; cloth, 9 in. x 12 in. Price $2. Published by the *Railway Age Gazette*, 83 Fulton street, New York.

This book will be ready for distribution July 10. Since the inauguration in September, 1909, of the Shop Section in first issue of the *Railway Age Gazette* of each month, every number has contained a large number of shop kinks. These have been received from several sources—by shop kink competitions, from special contributors and from investigations which have been made by the editors. Five general shop kink competitions have been held; also two engine house kink competitions and a car department kink competition. Special contributions containing a large number of kinks have been received from the Chicago & North Western shops at Chicago; the Silvis, Ill., shops of the Chicago, Rock Island & Pacific; the West Milwaukee shops of the Chicago, Milwaukee & St. Paul; and the Meadville, Pa., shops of the Erie Railroad. Among the shops which were visited by the editors in quest of kinks were the Mt. Clare shops of the Baltimore & Ohio; the Elizabethport, N. J., shops of the Central Railroad of New Jersey; the Delaware, Lackawanna & Western car shops at Buffalo, N. Y.; the Erie Railroad car shops at Buffalo, N. Y.; the Dale street shops of the Great Northern at St. Paul, Minn.; the Lehigh Valley shops at Sayre, Pa.; the Long Island shops at Morris Park, N. Y.; the New York Central & Hudson River car shops at East Buffalo, N. Y.; and the Delaware, Lackawanna & Western shops at Scranton, Pa. The kinks submitted in the competitions and special contributions were received within the limits of Cienaga, Cuba, on the south; Skaguay, Alaska, on the north; Albuquerque, New Mexico, San Bernadino, Los Angeles and Bakersfield, Cal., in the west; and the Atlantic seaboard on the east. The descriptions of the kinks have been carefully revised and many of the less important ones have been discarded. They have also been classified and arranged in seventeen chapters, as follows: Machine shop kinks; erecting shop kinks; boiler shop kinks; oxy-acetylene welding and cutting; blacksmith shop kinks, locomotive department and general; brass foundry kinks; tin and copper shop kinks; engine house kinks; car department kinks, general; steel freight car kinks; passenger car kinks; planing mill kinks; blacksmith shop kinks, car; air brake kinks; oil house kinks; paint shop kinks; miscellaneous kinks.

This classification has had to be made on a more or less arbitrary basis, since oftentimes the same kink may be used in three or four departments. A thorough index has, therefore, been provided. The value of the book will lie not so much in the fact that the kinks may be copied. as from the suggestions that will be inspired by its study, enabling the reader to perfect methods he may be using or to develop new labor-saving devices to suit his peculiar conditions. No attempt has been made to designate the best kinks or the best way of doing any one class of work, but in many cases a number of kinks are shown for doing the same job. The reader can thus study them and determine for himself which method will best suit his conditions.

Letters to the Editor.

SAFETY APPLIANCES.

West Albany, N. Y., June 12, 1911.

To the Editor of the Railway Age Gazette:

Your Wilkesbarre correspondent, writing under date of May 8, 1911, page 1251 of the June 2 issue, I fear either fails to understand just what I wished to convey, or (perish the thought) is interested in a chain type of pin lifter. He quotes from my article in the May 5 issue in which I stated that 60 per cent. of the uncoupling mechanism defects were due to (a) uncoupling chain broken; (b) uncoupling chain kinked; (c) knuckle pin broken; (d) block broken; (e) lock block inoperative—six different causes. Then follows the statement that uncoupling chains (which includes clevises) are responsible for 70 per cent. of this, and can be avoided by the use of a chainless lifter. Now 70 per cent. of 60 per cent. is 42 per cent., or *42 per cent. of the defects due to uncoupling mechanism are due to lift chains and clivises.* I did not say 70 per cent., but in effect 42 per cent. I believe most railway officers interested in this lifter question agree that the chain should be eliminated, and as I said there are pin lifters without chains that meet all requirements, and that are not rigid under abnormal conditions.

The defense of the chain lifter by "J. G." has reference to but one type of patented lifter, which requires about twice as much labor in its application as another chainless one which is more advantageous. Am not "interested" in any of these lifters, and this is an explanation, not a defense. My information was derived from the last annual report of the Interstate Commerce Commission.

C. L. ALDEN.

APPLICATION OF SCIENTIFIC MANAGEMENT TO A RAILWAY SHOP.*

BY MAX H. C. BROMBACHER.

The question which the *Railway Age Gazette* has propounded to the efficiency brethren, reads, and very appropriately, "How can scientific management be applied to railway repair shops?" It seems to the writer that any use of the word scientific in connection with the management of men, successfully, is a misnomer at best; it is hard to imagine an instance outside of a proposition in mathematics, or, outside of the performance of an autopsy, which would permit of scientific management, according to the real meaning of these words in actual practice.

Certainly, in any case where the human equation is the dominating factor, as is admittedly the fact in railway repair shops, scientific management in the correct sense is a practical impossibility. It may be qualifiedly possible in instances where the operator is a mere feeder to the machine, as is said to be the case in screw factories, since the element of personal judgment is largely if not entirely eliminated from the problem. All the treatises and explanations on the subject of scientific management, which I have seen and which were prepared by efficiency engineers, seem to indicate that the basis and superstructure of scientific management, so called, is such as would tend to effect the elimination of the factor of individual judgment. This alone would explain the practically unanimous opposition of railway repair shop heads to scientific management, since the element of personal judgment cuts a practically dominating figure in the management of their shops.

The words scientific management, functionalizing, despatching, etc., are part of a new terminology, which has been born or manufactured within the past few years; and, as our people dearly love a well turned phrase, or a phrase maker, they have attained and are enjoying an immense vogue at the present time. They do not describe anything really new; the same processes exist and have existed for ages; only, under the old terminology all were included and described by the humdrum expression of "thoroughly efficient management." This would seem to indicate that sometimes a rose under another name smells sweeter. The *Railway Age Gazette's* question of "How can scientific management be applied to railway repair shops," will be considered as meaning, "how can *thoroughly efficient management* be applied to railway repair shops," and, as every thing in the industrial world at least is relative, it follows that the question to be answered is in effect, "how can ***relatively*** thoroughly efficient management be applied to railway repair shops?"

The modern conception of relatively thoroughly efficient management is that type of management which shows in practice a relatively maximum output per operator, a relatively minimum cost per article and a relatively maximum earning rate per hour per operator. These requirements may to some sound like contradictions in terms; but they have been proved to be a realizable goal, and not infrequently at that, in industrial concerns. There is nothing visible to the writer in or about railway repair shops, which forbids its attainment in this class of industrial organization.

It may not be out of place to precede the statement of which system, if any, can be relied upon under proper auspices to attain these three desired results, by a statement of some of the reasons which make these results unattainable by other systems; and in this connection, it is the writer's opinion that the obtainment of the best in every operator is a condition precedent to even hoping to attain the results desired. It follows that any evident thing in any system which obviously precludes the idea of obtaining the best there is in operators, precludes the consideration of that system as a means to our end. It also follows that peace of mind upon the part of the operator is necessary before one can expect him to give his best, irrespective of what system he is working under.

Taking up first the flat rate, or daily wage system, we have to acknowledge that its inevitable tendency is to level down the good operator to the level of the poorer, if not to that of the poorest. As this is premiumizing inefficiency, it is automatically and diametrically opposed to the attainment of the desired results. It has been contended that a modification of this flat rate system by the granting of bonuses in addition to the flat rate, the bonuses consisting of a portion of the value of the increment earned by the operator through an increased output due to increased efficiency on his part, is bound to give the best possible results. But, though it may be possible that it gives better results than the flat rate system, and it certainly would be hard to get worse results than this flat rate is bound to yield in the long run, it does not seem possible to the writer that it should possibly give maximum output per operator, minimum cost per article and maximum earning rate per hour per operator.

Peace of mind on the part of the operator is absolutely necessary to his doing his best under any system, and this must be considered in the light of the fact that the operator is, in a state of nature, suspicious, and often justly suspicious of his employers. If there is any one thing which will throw an operator out of kilter as regards peace of mind, it is the slightest doubt as to how much he is earning, or has earned, and as to whether this has been calculated correctly. Now, under any form of bonus system, the figuring is bound to be more or less complicated. As the average operator is no mathematician, he is always prey to that innate suspicion of his employer, that he is not really sure that he got all that was coming to him in the first place, and as to whether the proportion he did get of the value of the increment accruing from his increased output was a fair portion, even if his pay check contains no errors in fact. These reasons indicate that we cannot expect to attain the desired results with any system which does not permit the operator to know where he is at every day in respect to his earnings, and which does not make clear to him that he is getting full advantage of his increased output due to his superior efficiency as an operator.

Based on individual experience and observation as a manufacturer, and supplemented by years of observation of the experience of other manufacturers, the writer's opinion is that maximum output per operator, minimum cost per article, and maximum earning rate per hour per operator, can only be attained in railway repair shops, or in any class of shops in which the element of personal judgment is a large factor in the success of the shop, by means of the proper installation of a ***really intelligent*** piece work system, and, in arriving at this conclusion he has not overlooked the basis nor the results of the *typical* piece work system. The bane of this latter system is that grossly ignorant employers will cut the rate as soon as an operator lets out a link in response to a tempting rate (price), so that the operator is practically reduced, as regards his earnings, to the flat rate limit, beyond which this action shows his employer to be determined he shall not go. Space limits preclude amplifying the asininity possessed by the employer who does this sort of thing, nor does our regret alter the fact that his name is legion. Suffice to say, that this kind of ignorant employer is the father of labor unionism "as she is played." The flat rate unionist premiumizes in efficiency; the rate cutting piece worker penalizes efficiency. The same result is arrived at by (apparently) opposite methods.

About the strangest system of piece work which ever came under the writer's observation was that in which a comparatively high price schedule was accompanied by a disproportionately low "dead line" of earning rate per hour which the men were forbidden to overstep. Luckily the number of instances of employers

*This article was awarded the first prize of $50 in the competition on How Scientific Management Can Be Applied to a Railway Shop, which closed June 15. Mr. Brombacher is a practical production or efficiency engineer with offices at 94 West 183d street, New York City.

who operate their shops under this system is very small; the inevitable result of this system is a comparatively maximum cost per article, accompanied by a forced decrease in the efficiency of the entirely innocent tool. It would be hard to find a system more admirably adapted to demoralize the morale of a shop, either as to ethics or practice.

As is the case with every system, really intelligent piece work requires the recognition of conditions precedent to its proper installation; some of these conditions are of an ethical nature, while others are almost entirely practical. While these conditions differ as to their nature, they are in almost absolute agreement concerning their importance as to the success or failure of the installation of such a piece work system. Incidentally, these conditions do not differ as to the fact that like other later day industrial policies they seem to indicate the desirability of a return to what might be called the first principles of industrial life—toward the application of paternalistic principles. Paternalism is not socialism. Socialism means equalization of earnings—an economic principle, even though it be unworkable in practice. Paternalism means a form of government or administration, and it has been proved to be a practical success. It leads, when properly understood and applied, straight to our desired results. It knows nothing about the equality of man; it is based on the frank recognition of the inequalities of man, i. e., that men are of vastly different efficiencies, and that equalization of earnings would, if enforced, tend to level the race down toward inefficiency.

It goes without saying, almost, that the question of how to supply relatively thorough efficient management to railway repair or other shops, permits of treatment from different angles. It can be treated from an angle which requires only the statement of broad general principles with the reason for them; again, it can be treated from an angle which, to do it justice, requires the writing of a good sized book. The judges in this competition are busy men, and could not reasonably be expected to wade through a book; and the attempt to apply relatively thoroughly efficient management, whether by one system or another, in shape of a book, would doubtless strike them as being similar to farming by book; it would be just as impractical, only very much more expensive; besides, it would be idle to affect ignorance of the feeling which is abroad in railway circles, that efficiency engineers and scientific management men have produced too many brilliant results in books, as differentiated from producing them in shops. The writer will, therefore, attempt to confine himself to treating the subject from the angle requiring only the statement of broad general principles with his reasons for them.

Apologizing in advance for the personal tone which utmost brevity consistent with clearness requires, the writer, assuming that he had been entrusted with the contract to introduce and install a really intelligent piece work system, would go about it as follows: It is assumed, of course, that the shops are fairly modern as concerns both design and equipment and that the tools have a surplus of power; that, as he would naturally have to work and effect results by and through the shop head, that the shop head be intelligent, and affirmatively sympathetic with the idea that conditions as susceptible of improvement in most any shop, his shop included. If these conditions, which are elemental, did not exist, it would be best to quit before a beginning was attempted. Nothing can be done where the agent through whom results have got to be reached is either unintelligent; i. e., immune to ideas not originating in his own cranium, or where the equipment and design are antiquated.

A request would next be made to the management to permit of the installation of what is sometimes called welfare work; that is, installing a surgeon and nurse whose duties will be to treat the injuries of the men, slight or serious, at once and with no charge to them. Part of their duties would be to not only apply what is sometimes called first aid to the injured, but to see to the care of the injuries, including dressing them, from the time of the accident to the time the operator returns to work. Either the nurse or the surgeon should always be at the shop, if it is of ordinary size. When the surgeon is visiting those whose injuries do not permit their being at work, the nurse should be at the shop to take care of the men. No man who cuts or jams his finger even, should be allowed to bandage the injury. The nurse should do this; incidentally there would be no cases of prolonged loss of work through dirt being left in the wound, nor of any of the ills which follow unskilled attention to injuries at the time they occur. When the nurse is out renewing dressings for patients confined to their homes (which she should do under the direction of the doctor) the doctor should be at the shop.

The idea underlying this suggestion is that the men are relieved from the worry which otherwise always hangs over them, of loss of time and money through injuries which are common to their calling; no one can do his best in that frame of mind. Again, it tends to arouse or generate a feeling of personal loyalty upon the part of the men toward their employers. This treatment does not affect the self-respect of men, because they know, and intelligent employers have discovered, that it pays the employers, and hence is not charity. The men, however, recognize the fact that it involves considerable thought and work on the part of the employer. This is a suggestion with a statement of the reasons therefor; it is not intended as an ultimatum. Conditions in the shop could be materially improved, even if the management turned down this suggestion; the writer can understand that the management might be more willing to install this sort of thing after having seen evidence of results from the application of other suggestions, rather than in advance. He is himself prone to prefer things which are visible to the eye physical, to those things visible only to the eye of faith in matters of this world.

The writer considers the above suggestion, with the succeeding and every other suggestion which will be found herein, to be essentially educational; he recognizes that only as a result of real education can conditions be improved. He knows of no agency more effective in building up the standards of life and living, than a really intelligent piece work system, faithfully carried out; and experience has convinced him that this is due to the fact that it is based on and carried out in a really educational sense.

The next suggestion would be the installation of instruction for the apprentices in mathematics, physics and chemistry during their employment. Stress is laid upon their receiving this education while being employed, because the only real education is that where, if at all possible, the acquirement of practice precedes or at least is synchronous with the obtainment or acquirement of theory. An operator who knows why he knows, or does, what he knows, or does, is infinitely superior to the operator, however, skillful he be, who does not know why he does what he does. And this applies in even a greater degree to higher education. The college graduate who gets his practical experience, before or as he he goes through college, is worth a car load of the other kind of college graduates. Nowhere is this more true than in a railway shop, and nowhere has the typical college graduate been productive, though unconsciously, of greater errors than in just this class of shop. The writer is not unaware that some railway shops have an apprentice instruction system installed. This, unlike modern design and equipment, is not initially, at least, part of his requirements. Outside of the evidence it affords of the intention of the management to aid in every reasonable and practical way in the upbuilding of its employes, its results will show later in that it incidentally tends to enable a shop to develop its own skilled operators.

It goes without saying that a condition precedent to the successful working and proper installation of a really intelligent piece work system is that the men believe or be brought to believe that the principles of the square deal are the practice;

this will be referred to later on in connection with the price schedule. It is one of what might be called the ethical conditions underlying the proper installation of this kind of piece work.

In the formulation of price schedules, the writer would be guided almost entirely by the caliber, mentally and mechanically, of the shop manager. Speaking generally, but with special application, the writer bases this on the fact that the day-work rate should be the compensation for the average man; hence the schedule would afford opportunity for a good man to earn at least 25 per cent. more per hour than the day-work rate; and it follows that a very good man could earn much more than 25 per cent. over the day-work rate. Unless the working head of the shop (and his superiors) were thoroughly in sympathy with the idea that within competitive limits, the more the earning rate per hour of the operator increased, the better they would be pleased, it might appear to be necessary to do some preliminary educational work in the case of the management itself. Almost any increase in the earning rate per hour per operator, is, if accompanied by an increase in operator's output, advantageous to the management. And where, as in the case of intelligent piece work, the increased earning rate per hour is conditional upon at least a pro rata increase of output upon the part of the operator, the management is all to the good, since the increase of output decreases the percentage of the burden per unit of output; this sounds elementary to the verge of kindergartnerish, yet the writer has met heads of large concerns, who took issue with this statement at first glance, but were compelled to admit its essential soundness upon reflection. But when it came to putting it into practice they simply could not do it; they preferred blundering on in the old way of cutting the rate whenever a man let out a link, yet could not understand the to them disproportionate percentage of burden to output.

In introducing the price schedule, the writer would prefer that the shop manager be a man who achieved his position of leadership along old fashioned lines, i. e., by virtue of having demonstrated his right to the place by reason of his superior skill and ability, and by always holding his mind open to new ideas, not necessarily to their immediate acceptance, but to at least looking into them and, if found feasible, to trying them out. This kind of a shop head will, if the shop is run on the principles of the square deal, always enjoy the respect and confidence of his men. Working men seldom refuse the tribute of their respect and confidence to a shop manager of this kind. He gets their respect by virtue of his ability to show them with his hands, as differentiated from showing them with his mouth, the best manner of doing a given job if necessity arises; and by virtue of their knowing that he knows what a day's work is for the various classes of operators into which the men are divided by their natural differences in ability.

A price schedule, formulated by and with the advice of this kind of a shop head, will seldom require revision downward, except as the result of the introduction of improved equipment or labor saving devices. It is not claimed that the writer or such a shop head are infallible, that they never get a price too high. Such a shop head will also make mistakes in the other direction and will perhaps base a price on the ability of a good man instead of on the ability of the average man. As soon as this is discovered he will revise upward. One such case will enable him to correct many mistakes, if necessary, in the other direction without shaking the confidence and respect of the men under him either as to his fairness or of his knowledge of the business. Most revisions in most shops are the result of ignorance by the formulators of the original price schedules of a personal knowledge of what constitutes a day's work on a given job.

It may be that the price schedules are the result of the combined wisdom of a "bureau of statistical research," or of "compared efficiencies" taken in connection with the findings of the most (apparently) efficient shop of a number of really inefficient shops; or it may be that a body of college graduates, working in connection with stop-watch artists, have formulated the price schedule. It need not even have been observation by stop watch; it may have been just plain observation; but in either case, not having a personal knowledge themselves as to what constituted a day's work on the different jobs, they were stop-watching or observing "soldiers in the worthy cause of a day's pay for ½ day's work." Again, the schedule may have been formulated on the "hit and miss" principle; in this event, it will contain prices which not only do not afford a good man an opportunity to earn at least 25 per cent. more than the day-work rates would have netted him on the same job, but his returns are often less than when working on the day rate basis. The shop head who would permit such a condition of affairs to pass him more than once, even if the operator affected did not object, is admirably adapted to realize low efficiency in his shop and remain in serene ignorance of the cause thereof.

If the shop manager were intelligent and desirous of seeing the efficiency of his shop increased, but unfortunately was not of the kind described as being able to show with his own hands that his price schedule was fair and that he could come pretty close to earning a large increase over the day work rate on a given job, the writer would suggest having recourse to men who could do just this. The writer never makes a price on a job under given conditions, but what he has men where he can lay his hands on them, who can show that the price is good for an increase to them of about 50 per cent. or more over day-work rates. If an operator balks at the fairness of a price, and is shown by demonstration that 50 per cent. or over is being earned and can be earned over and above the day-work rate, he generally applies for leave to withdraw his objection to the fairness of the price. There is no after-clap to that sort of argument; it is the kind that appeals to the operators.

Just a word regarding claims which some efficiency engineers assume not only to be the prerogative of their systems, but which they almost claim to have patented for their systems. This refers to the matter of full and accurate records, of detail management and accurate individual records of each operator; and also, to the claim that predetermined costs and the striving therefor and, when reached, the maintenance thereof, in conjunction with some sort of bonus system, is not only the best method of attaining maximum output, minimum costs per article and maximum earning rates per hour per operator, but that these systems of keeping these accounts are the only proper ones.

This question of records is, with some of the efficiency systems, a fearsome thing; the writer has read papers in which it is claimed that it has been found to pay to have as many as three non-producers to one producer. The writer has seen many systems based upon "full and accurate records" commence as "buds of promise," but alas for human hopes they never "blossomed into flowers of performance," except that it was ascertained that the system cost more than the business could net in the shape of profit; the result was a rather premature demise of the system, accompanied by the consigning of its inventors to Hades by the victims gullible enough to try it at their expense.

The truth is, that a really intelligent piece-work system would give the shop manager every detail necessary to enable him to know where he was at, both in respect to any department of his shop, or for any operator in any department; so much for the matter of full and accurate records. As regards getting the best possible results from an operator by reason of his knowing that his record was known to the management, that is also covered. In addition to this, each individual operator in a shop governed by the principles and practices of really intelligent piece-work systems knows that he is perfectly safe in studying at any time and all the time as to how he can get his work out quicker; he knows that he will get the benefit of anything he does in that way. He knows that the shop superintendent is anxious to co-operate with him along these lines; and he knows that he will

never be penalized for using his brains by having his rate cut by the management, because they know enough to know that he is decreasing their costs (reducing their percentage of burden) by his increased output, and this insures a lower cost per article than any system of predetermined cost would produce outside of a book. His pay check evidences in increased size the recognition that the management knows him to be an efficient unit; and he knows by his daily life in the shop that the set of records kept there, simple though they may appear, are sufficient to keep tab on every move made by every man in every department of the shop.

These records would provide in a simple manner for the dividing of the shop into departments, by the listing of every operator's name under the heading of his department, and by the classification in every department of the operators in that department, i. e., in the machine shop, as machinists, machinists' helpers, apprentices, etc., and so on down through every department in the shop. The shop manager could then have a simple report with about 12 headings covering the items of piece work hours, day work hours, piece work amounts (earnings), day work amounts, day work rate, piece work rate, a column to show the amount of earnings over and above day work rates and another a column showing less, if any. On the line below and at the left of these headings, would follow the name of each man. On another sheet, there would be kept a summary of the foregoing; and on still another a comparison of this summary month by month, which would include the names and salaries in each department of the shop, as well as in the office of the shop, of what might be called the non-producers, such as clerks, telephone operators, etc. This sheet would give the percentage of piece work to day work for the shop as a whole; and thus monthly, weekly and yearly comparisons are at hand for the shop manager, giving him every detail of every department and of the earnings of every man under him in the entire shop. These, with a copy of the price schedule, and of the requisitions for materials and supplies contain about as complete, yet as simple and inexpensive a system of records as can well be imagined. They constitute a chart which precludes the idea of the shop head going on the rocks—if he keeps his eyes open. Taken in connection with a similar system for the other shops of a railway they constitute a quick method of comparing division efficiencies over the whole road; if copies of each monthly summary be exchanged between division heads, they serve not only to spur each shop superintendent to increased efficiency, but if the detailed monthly showings are exchanged they serve to put each division shop head wise as to where he can improve his own administration.

It will be observed that my system is based on the shop manager having all the figures, including the price schedule of his own shop, under his hands at all times; there will be at least weekly consultations with every foreman and sub-foreman present, at which the details of each department will be gone over. In this way no unpleasant surprises will develop for the shop head, either as to a given job or man. If a man's record shows that he cannot or will not rise above the day work rate, inquiry is made as to whether he needs instruction or whether it is a case of unconquerable inertia. If the former, instruction is given, and if the latter, the man is moved. It would be unfair to the shop's record and to the tool to allow this kind of an operator to keep the efficiency of the tool 25 per cent., or over, below normal; neither humanitarianism nor common sense require the tool to be penalized in this way.

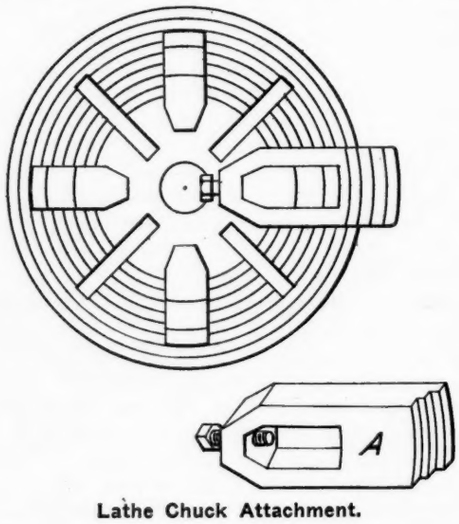
The above system of giving the shop manager control of at least a copy of the records pertaining to his shop, is not intended to debar the management from permitting the accounting department all the activities it sees fit to indulge that department in. It is intended to limit the activities of the accounting department as to its tendencies to assume that statistics are its sole property and its sole concern. The records described above constitute in effect the shop head's chart; a chart is needed and is useful before, not after, a vessel has gone on the rocks. A shop head, as regards records, "wants what he wants when he wants it;" not when the circumlocution office gets around to it. Take the column of possible earnings by an operator at less than day-work rate; with this knowledge confined to the accounting department, the shop head lies under the imputation of being unfair to the man; if the man makes an objection, time is lost getting the facts necessary for an investigation; perhaps a good man leaves. By the other method, the shop head either knows of it at once, or he is in position to investigate at once; the men's confidence in his fairness is retained and this is quite necessary.

In conclusion, the question may be asked as to the concrete results which the writer thinks possible to show by the installation of such a piece-work system as herein outlined. The answer is impossible to give off-hand and in definite statements without knowing something of the conditions to overcome and of the atmosphere under which the problem would have to be handled. And this would be the case even if the question were asked with the questioner before me, and with the latitude which conversation permits in answering questions intelligently.

Speaking, therefore, generally, from my knowledge of the piece-work schedules of several roads in the Eastern Traffic Association, and of the costs on given jobs of roads which are not operated on the piece-work plan, I estimate that at least 25 per cent. could be saved by the installation by me of "a really intelligent piece-work plan" on the present costs of running repair shops by most of the roads in the Eastern Traffic Association. This is predicated on the assumption that the design and equipment of the shops are fairly modern; if strictly up to date a still greater efficiency might be reasonably expected.

LATHE CHUCK ATTACHMENT.

The attachment shown in the accompanying illustration is in use at the Canadian Pacific shops, Montreal, Can., and serves to increase the radius of usefulness of an ordinary lathe chuck of small dimensions. It consists of auxiliary jaws *A* that slip over the regular jaws and are held in place by set screws. The



Lathe Chuck Attachment.

one shown is intended for holding piston rings or other hollow work that may be caught on the inside. It is evident, however, that a modification of the same arrangement having an overhang, may be applied, by which larger diameters may be chucked than would be possible with the regular chuck.

The Prussian legislature recently voted money to electrify a section of the road in Silesia, which runs through a semi-mountainous region with many variations of grade.

SETTING INSIDE ADMISSION PISTON VALVES WITH WALSCHAERT GEAR.*

A design of Walschaert valve gear used with inside admission piston valves is shown in Fig. 1. The names of the various parts are as follows: *A*, valve; *B*, valve stem; *C*, combining lever; *D*, crosshead link; *E*, radius rod; *F*, reverse shaft; *G*, lifting link; *H*, reach rod; *K*, reverse lever; *L*, reverse link; *M*, eccentric rod; and *N*, eccentric crank. The main pin is shown on forward dead center and the reverse lever is in its middle position, with the link block in the center of the link. A careful study of the diagram shows that with a valve having inside admission the valve rod is connected to the combining lever at a point *below* the latter's connection to the radius rod. If the block is in the *lower* half of the link when in forward gear, the eccentric crank *follows* the main pin. If the block is in the *upper* half of the link when in forward gear, the eccentric crank *leads* the main pin.

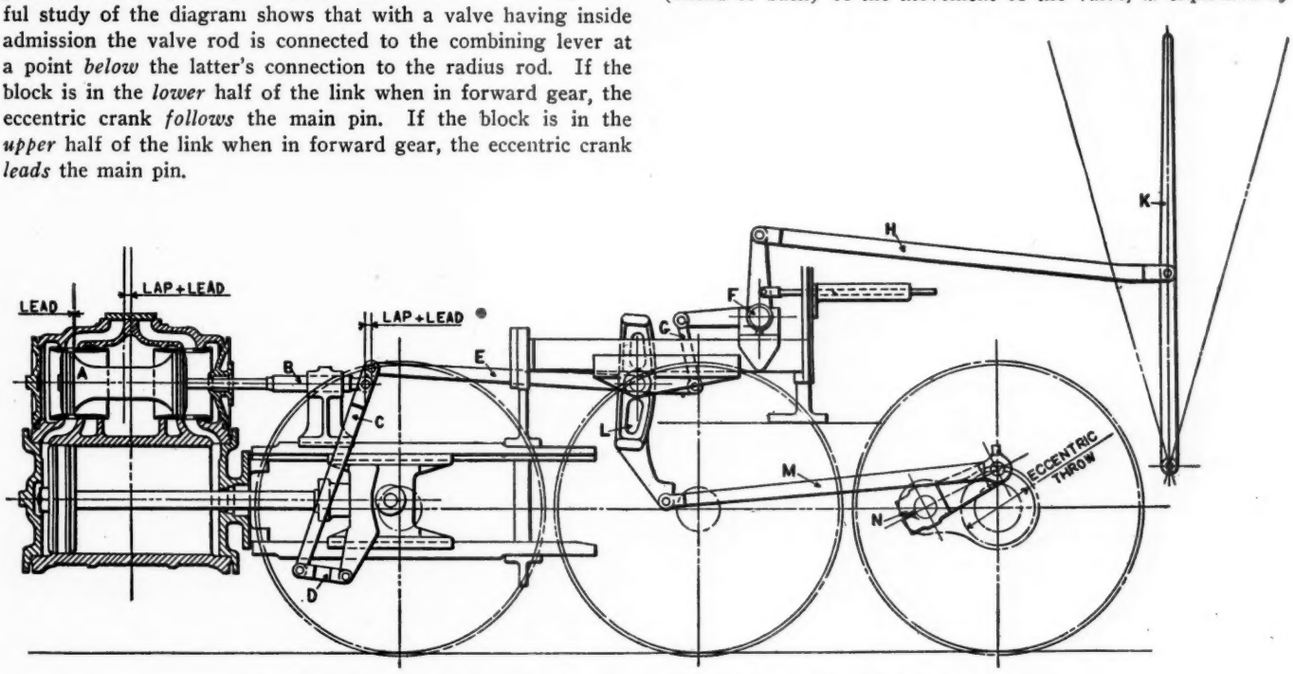


Fig. 1—Walschaert Valve Gear as Used with Inside Admission Piston Valves.

The method of setting inside admission piston valves is generally similar to that for outside admission valves, as described in the *Railway Age Gazette* of June 2, 1911, page 1254. It must be remembered, however, that to perform corresponding functions this valve moves in a direction opposite to that of the slide valve. When setting piston valves, the steam chest heads should be removed, for the sake of convenience. The line and line positions of the valve are determined by observation through peep holes provided for the purpose. In this way the points *F* and *F'* (Figs. 2 and 3) are located on the valve stem by tramming from any convenient point on the back wall of the steam chest. The lead points on the valve stem can thus be obtained by placing the crank on the dead centers, and again tramming from the steam chest wall (Fig. 4). The test for lead is made as described for the outside admission slide valves, the combining lever occupying positions as shown in Fig. 5. The lead in full gear, with this style of valve, is examined precisely as for outside admission valves.

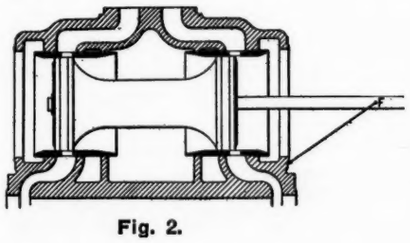


Fig. 2.

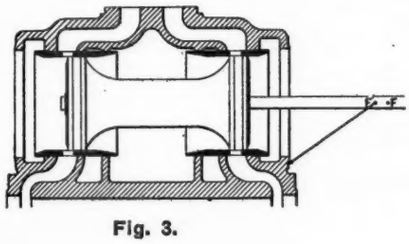


Fig. 3.

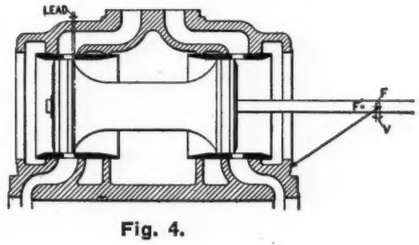


Fig. 4.

*From Record No. 70, published by the Baldwin Locomotive Works, Philadelphia, Pa., and entitled "Walschaerts Valve Gear."

CORRECTIONS.

Methods used for correcting errors can be best explained by two hypothetical cases. For example, suppose the specification of a locomotive having inside admission piston valves, calls for the following:

Maximum valve travel, 5¾ in.
Eccentric crank throw, 15½ in.
Constant lead, ¼ in.
Steam lap of valve, 1 in.
Link block below link center in forward gear.

The influence of the eccentric rod changes on the direction (ahead or back) of the movement of the valve, is explained by reference to Fig. 6. An examination of this figure will show that if the eccentric rod *E* is lengthened to *E'*, then the radius rod *R* will be moved ahead to the position *R'*, and the valve stem will be moved a distance *X* in the direction of the arrow, thus displacing the valve from position *V* to *V'*. Therefore, the rules applying in the case of outside admission slide valves also apply to this style of valve, as follows. In forward motion if the eccentric rod is lengthened, the valve is moved ahead. If the eccentric rod is shortened, the valve is moved back. In backward motion if the eccentric rod is lengthened, the valve is moved back. If the eccentric rod is shortened, the valve is moved ahead.

If the link block is above the center when running ahead, then, in each case, the valve will be moved in the direction opposite to that stated above.

In any case, regardless of whether the gear is in forward or backward motion, to move the valve ahead, lengthen the radius rod the amount desired. To move the valve back, shorten the radius rod the amount desired. It must be remembered that with an inside admission valve, the front port opening is in-

creased if the valve is moved ahead, and the rear port opening is increased if the valve is moved back. Bearing these facts in mind, two hypothetical cases will now be considered.

HYPOTHETICAL CASE NO. 1.

Let it be assumed that on tramming to the valve stem with the main crank on the dead centers the following irregularities in the lead are

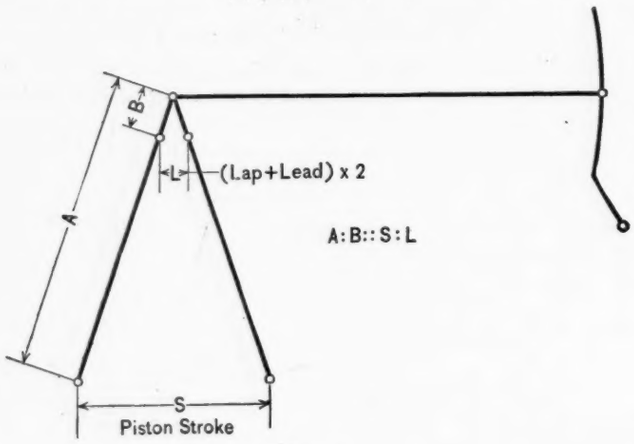


Fig. 5.

Error in forward motion—

Front, 3/8 in. — 1/4 in. lead = 1/8 in. error.
Back, 1/4 in. lead — 1/8 in. = 1/8 in. error.

{To square the lead, the valve must be moved 1/8 in. back.

Error in backward motion—

Front, 7/16 in. — 1/4 in. lead = 3/16 in. error.
Back, 1/4 in. lead — 1/16 in. = 3/16 in. error.

{To square the lead, the valve must be moved 3/16 in. back.

As the errors in the two motions occur in the same direction, it follows that the greater one partialy neutralizes the effect of the lesser, and that the combined or average error will be the difference between the two, viz.: 3/16 in. minus 1/8 in. equals 1/16 in., the average error.

To divide an average error of 1/16 in. equally about a central point, it will be necessary to move the valve one-half the amount, or 1/32 in. (in this case, 1/32 in. ahead in forward motion).

In the engine now under consideration, the eccentric crank throw is 15½ in. and the valve travel 5¾ in. Hence the ratio of eccentric throw to valve travel, is approximately as 2.7 to 1. Therefore the eccentric rod must be lengthened 2.7 times 1/32 in., or approximately 5/64 in. to move the valve ahead 1/32 in. When this has been done, the valve stem points will tram as shown in Fig. 8.

The errors in forward and backward motion have thus been equalized, and it remains only to square the lead front and back for both motions. The valve as now standing is 5/32 in. too far ahead to equalize the lead, viz.:

13/32 in. — 1/4 in. lead = 5/32 in. error front.
1/4 in. lead — 3/32 in. = 5/32 in. error back.

As the influence of the radius rod is direct, it follows that by shortening the rod 5/32 in., the valve will be moved back that amount and the lead squared. The valve stem can then be trammed to the dimensions shown in Fig. 9. These dimensions are the ones required by the specification.

The valve has thus been squared and the errors corrected by the changes

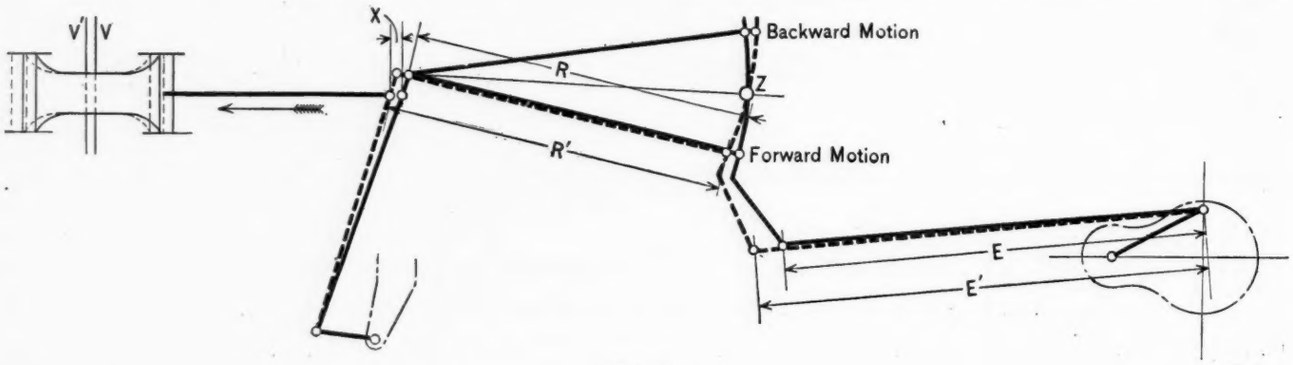


Fig. 6.

noticed for the engine under consideration. The dots on the diagram represent the prick punch marks *F* and *F'* (Fig. 3) on the valve stem, while the crosses represent the irregularities in the lead when trammed to the valve stem (Fig. 7). These irregularities are the same as those used in the corresponding case for slide valves, therefore the same diagrams are referred to.

The first procedure will be to divide the error between the forward and backward motions, as follows:

noted below: Eccentric rod lengthened 5/64 in. Radius rod shortened 5/32 in. A final trial of the valve and cut-off, etc., can now be made in the previously described manner.

HYPOTHETICAL CASE NO. 2.

Let it be assumed that on tramming for lead, results are obtained as represented by Fig. 10. Divide the error between the forward and backward motions, as follows:

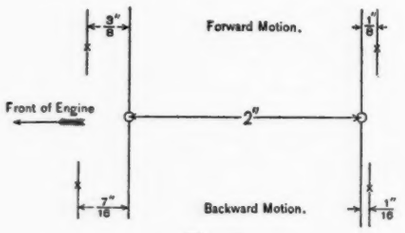


Fig. 7.

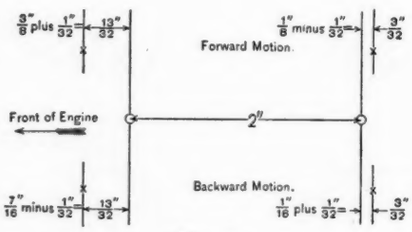


Fig. 8.

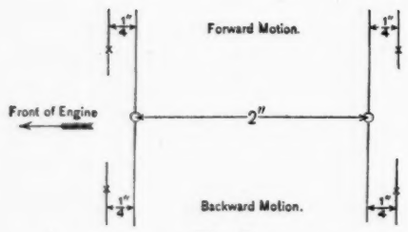


Fig. 9.

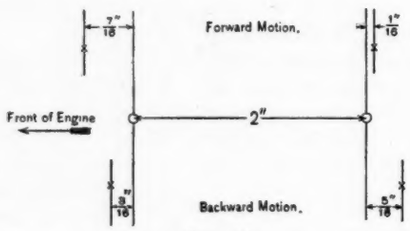


Fig. 10.

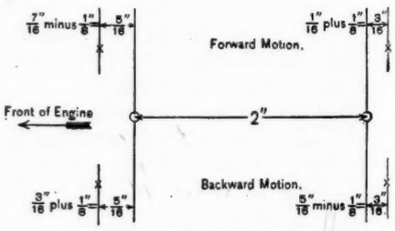


Fig. 11.

Error in forward motion—

Front, 7/16 in. — ¼ in. lead = 3/16 in. error.
Back, ¼ in. lead — 1/16 in. = 3/16 in. error.
{ To square the lead, the valve must be moved 3/16 in. back.

Error in backward motion—

Front, ¼ in. lead — 3/16 in. = 1/16 in. error.
Back, 5/16 in. — ¼ in. lead = 1/16 in. error.
{ To square the lead, the valve must be moved 1/16 in. ahead.

As the errors in the two motions occur in opposite directions they augment each other, and the combined or average error will be the sum of the two, viz.: 3/16 in. plus 1/16 in. equals ¼ in. average error. To divide the error equally about a central point, it will be necessary to move the valve one-half the amount, or ⅛ in. (in this case ⅛ in. back in forward motion).

The eccentric rod must be shortened 2.7 times ⅛ in., or approximately 11/32 in., to move the valve ⅛ in. When this has been done, the valve will tram as shown in Fig. 11.

The errors in forward and backward motion have thus been equalized, and it remains only to square the lead front and back for both motions. The valve as now standing is 1/16 in. too far front to equalize the lead, viz.:

5/16 in. — ¼ in. lead = 1/16 in. error front.
¼ in. lead — 3/16 in. lead = 1/16 in. error back.

To move the valve back 1/16 in., the link radius rod must be shortened 1/16 in., and the lead will then be squared. When trammed for lead, the results will be as shown in Fig. 9. These dimensions are the ones required by the specification.

The lead has been squared and the errors have been corrected by the changes noted below: Eccentric rod shortened 11/32 in. Link radius rod shortened 1/16 in. Trial of the valve travel and cut-off, etc., can now be made in the manner previously described.

EDUCATION AND DEVELOPMENT OF APPRENTICES.*

BY E. B. RALPH.

Apprentice Instructor, Atchison, Topeka & Santa Fe, Fort Madison, Iowa.

Before the Santa Fe adopted its present method of educating apprentices, few, if any of the graduates, were considered to be worth full mechanic's wages at the shop where they had served their time. They were thus encouraged to leave the parent shop and gain further experience in some other shop on the system or on some other road, after which they would be received back at full pay. These boys generally remained away. Under the present system of training they are encouraged from the time they begin their apprenticeship to remain in the company's service. The company has found them to be much better mechanics than it is possible to hire from other places, not only from the fact that they are trained to Santa Fe methods and standards, but they are educated along certain lines which required the "old timer" years of good hard experience to gain. They can start in at the completion of their apprenticeship and fill better positions and do better work than the "old timer."

To produce good mechanics the boys cannot be left to the mercy of the foremen alone, for the foremen are too heavily burdened with other duties to give the apprentice proper attention. Special men must be assigned to this work, and they must be thoroughly trained and competent in their particular line of work. This was accomplished on the Santa Fe by placing instructors in the various departments of the different shops. Wherever possible men who had served their apprenticeship on the Santa Fe were utilized for this purpose. They were thus not only skilled mechanics, but were familiar with Santa Fe methods and standards, and, better yet, were acquainted with the Santa Fe men and boys over whom they would have control.

It is the special duty of these men to receive the apprentice when he first starts in the shop, and follow him through the several branches of his chosen trade, giving him personal attention until he has passed through all that pertains to his particular trade, according to the facilities afforded by the shop in which he is working. These instructors are amenable to the general foreman and their superior officers only, which organization makes possible the best results. The instructor, with the approval of the general foreman, outlines a schedule of the different departments through which the boy must pass before completing his time. If the shop to which the boy is assigned does not contain facilities ample for a thorough knowledge of his trade, he is transferred to a larger shop to complete the last year or so of his apprenticeship. In this way all the apprentices, no matter where located, have the advantage of gaining a thorough training in their particular trade so far as it is able to be taught by the Santa Fe.

There is a well organized school system in connection with the shop instruction. At the larger shops a special man is assigned to look after the school, but the smaller places are taken care of by traveling instructors, their work being so arranged that each apprentice receives four hours school work each week, in periods of two hours each. These school instructors are technical school graduates, and as far as possible men who were employed in the mechanical department of the Santa Fe. While the school is made sub-servient to the shop, yet each boy is compelled to be present for four hours each week. If business be such that he has to be retained in the shop during his regular class period, he makes up this time at the first opportunity. Mechanical and free-hand drawing, shop mathematics and the rudiments of mechanics are taught; all in such a manner that they may be applied to the boy's daily work, and thereby keep him more interested in it, and more desirous of pursuing his studies when in school.

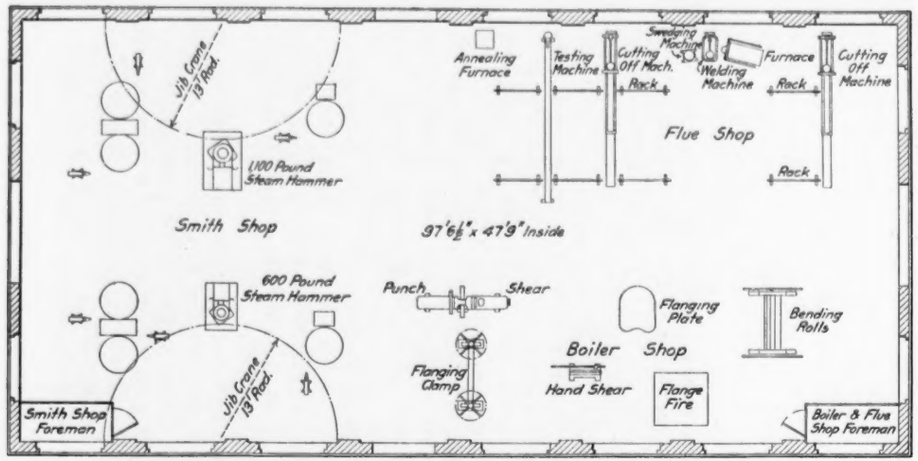
The obstacles encountered in establishing this system on the Santa Fe, so far as the writer's knowledge is concerned, were few, due to the efficient organization established to put it into operation. The best possible man for the head of such an organization was selected, one who had worked for years in the mechanical department as an official, and had become well acquainted with the various division officers with whom he was to come in contact. He is a technical school graduate, but a machinist by trade, and best of all a first-class mixer, one who has that wonderful ability to make all his subordinates fall thoroughly in love with their business. He, in turn, selected men for instructors who were able to mix with the boys. Unless an instructor can do this, he will not last long on the Santa Fe.

The system has been very effective in producing a good moral effect on the apprentices and shop men. The apprentices in particular are encouraged to seek good clean sport, and to this end, athletic teams have been organized along the system. The teams of the different shops meet each other in friendly contests. At these games will be seen some of the higher officials. This is noticed by the boys, who feel that they are being recognized and as a result they return to their work with a greater ambition. They are also encouraged to clean-up before leaving the shop after quitting work for the day; to seek the better places of amusement; and not to indulge in pastimes which are not for the bettering of themselves and their fellows. To assist in accomplishing this, a set of rules has been drawn up for the apprentices, containing nothing which will interfere with their pleasure or work, but which will help them to seek a better view of life, and thereby gain a better opinion from the people of the community. To further assist in guiding the boy right, there has recently been inaugurated on the Santa Fe, at some of the larger shops, reading rooms for the apprentice. At the other points the instructors are encouraged to have the school rooms open at night, that the boys may congregate there and play clean games and meet in a social way.

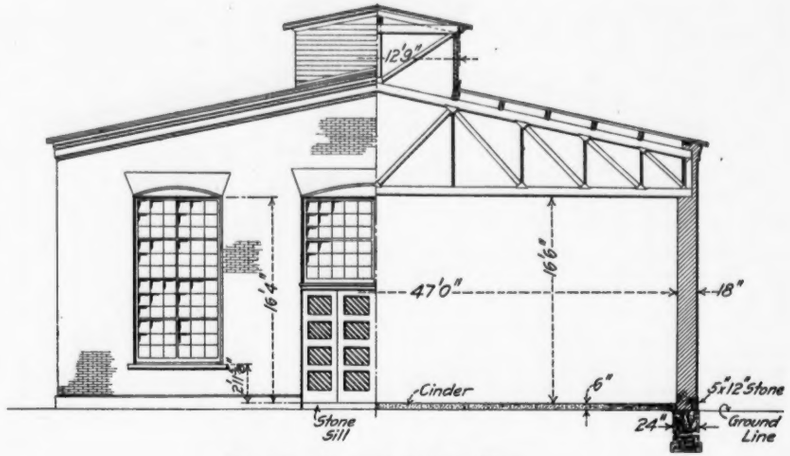
The effect has been such that the apprentices in their first and second years are now doing as well in their shop work as the average journeymen. About twenty of our graduated boys are holding good positions, although the system of instruction is only about three years old. Does it pay? Ask any mechanical department officer on the Santa Fe.

*Entered in the competition on the instruction of apprentices and workmen which closed April 15, 1911. Mr. Ralph's comments are especially interesting in view of the fact that he served his apprenticeship at Fort Madison before the new scheme of apprenticeship was introduced and is thus able to realize more clearly the advantages which it has to offer to the boys.

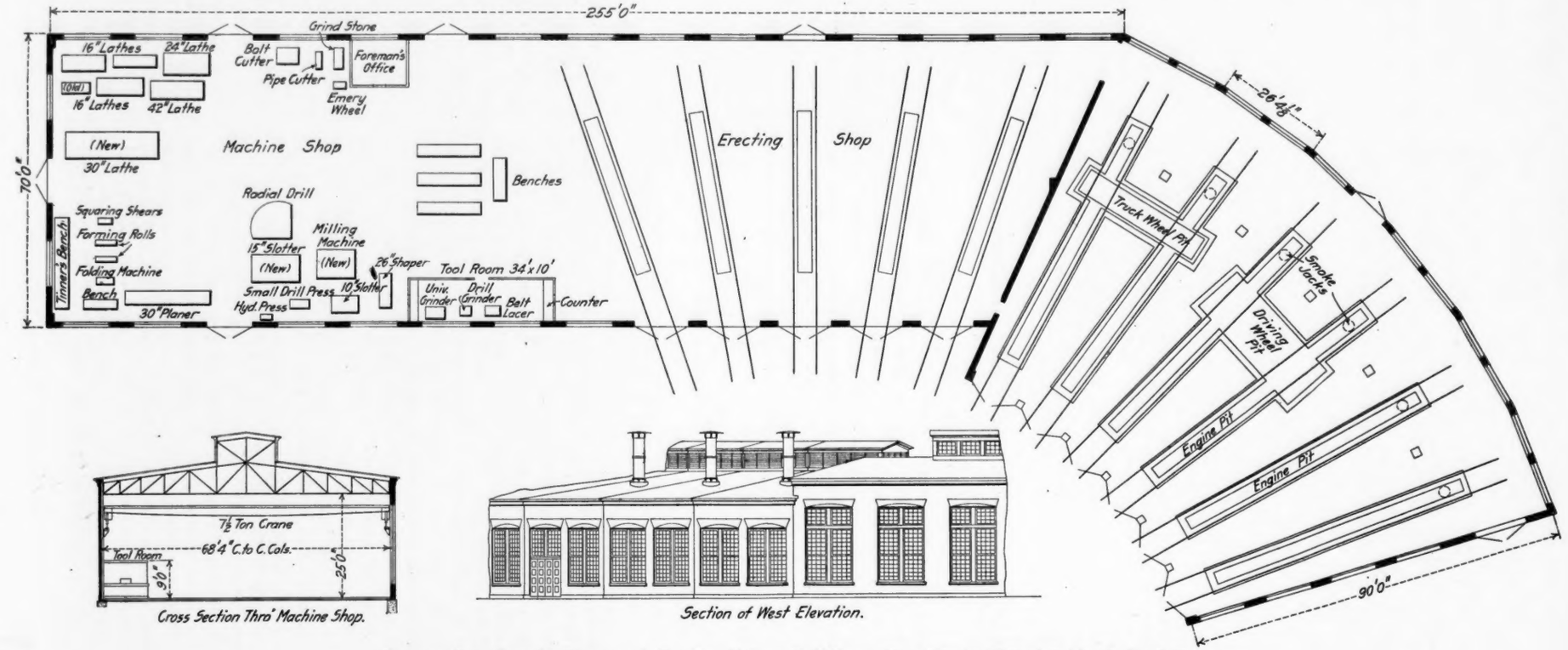
The Chilean government has under construction nearly 1,500 miles of railway, the cost of which will be about $75,000,000.



Arrangement of Equipment in the Smith, Boiler and Flue Shop.



Blacksmith and Boiler Shop.



Locomotive Repair Shop and Engine House Building; New York, Philadelphia & Norfolk.

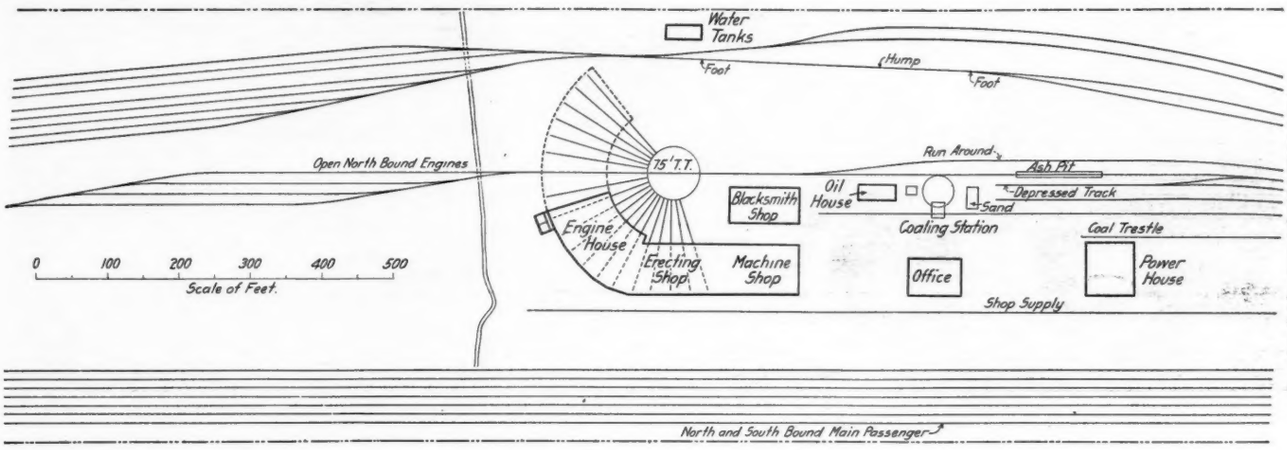
NEW SHOPS OF THE NEW YORK, PHILADELPHIA & NORFOLK.

A unique arrangement for the engine house, erecting and machine shop has been adopted by the New York, Philadelphia & Norfolk in its new locomotive repair shop plant at Cape Charles, Virginia. These shops were built to replace those which were erected when the road was originally constructed and will enable all repairs to be made to the locomotives, except for the heaviest boiler repairs. The engine house is at the end of the erecting shop with a common wall between, and the five tracks in the erecting shop radiate from the center of the turn table so that the locomotives are run into the shop directly from the turntable, making unnecessary the use of either a transfer table or of cranes for lifting the locomotives from track to track inside the shop.

The erecting and machine shop is 70 ft. 6 in. wide and 255 ft. long, 153 ft. being used for erecting shop purposes. A runway is provided for the future installation of a crane for the handling of material in the erecting shop and machine shops. All the buildings are of brick construction, and are well lighted, ventilated and heated. The machine shop contains the various tools transferred from the old shop, which are arranged in groups for motor drives, with the exception of one or two tools to which individual motors have been applied. The new tools installed include a 30 in. x 16 ft. engine lathe, a 15 in. rapid production slotter, a universal milling machine and a pipe cutter. All of these tools have individual motor drives.

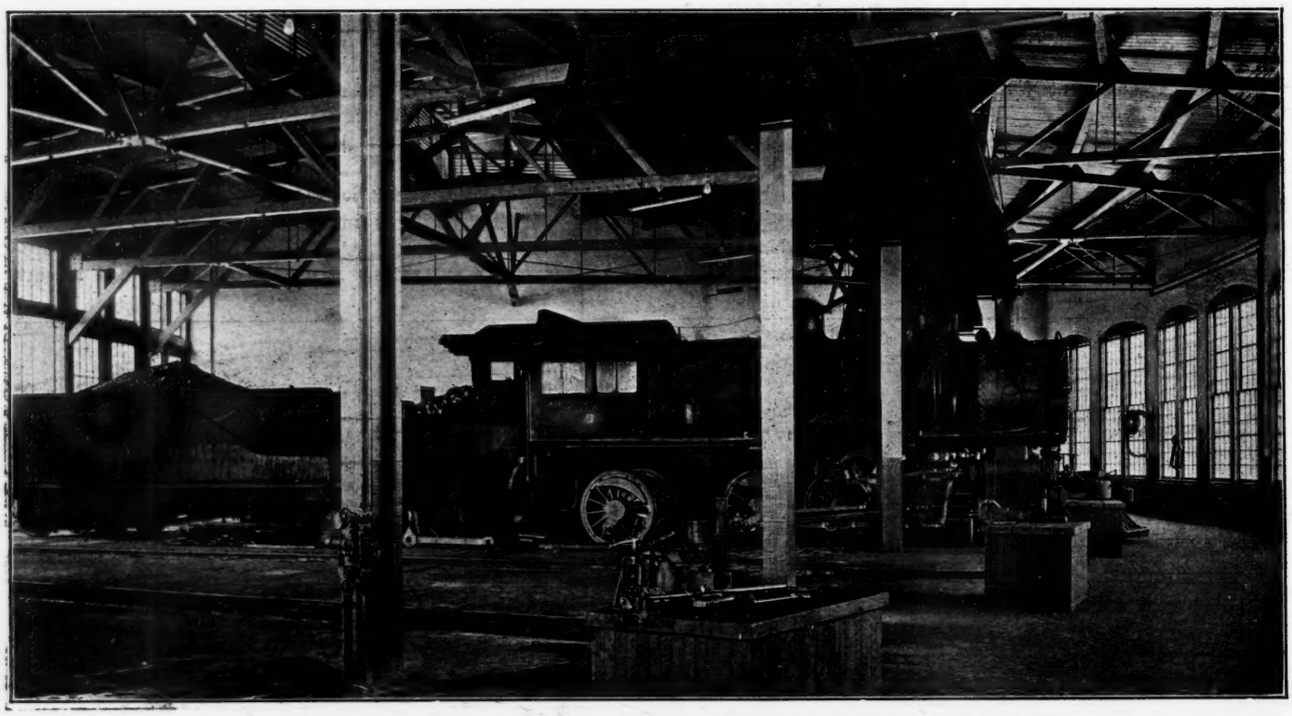
The engine house, which measures 90 ft. from the inner to the outside circle wall, is immediately adjacent to and connected with the erecting shop. It contains six tracks with provision for future extension. A driving wheel pit, and a truck wheel drop pit each serve two tracks. Cast iron smoke jacks are installed and the floor of the engine house, as well as the floor of the erecting shop, is of creosoted blocks.

The smith, boiler and flue shop is 50 ft. x 100 ft. The boiler shop tools, as well as the flue shop tools, are motor driven; among the new tools are a combined punch and shear, a 1,100 lbs. capacity steam hammer, a flue furnace, and pneumatic flue welding and swedging tools. The oilhouse is 22 ft. x 53 ft. in size, and contains a sweat room, waste room and distributing room, the various oils being placed in the storage tanks and drawn by gravity.



General Arrangement of the New York, Philadelphia & Norfolk Locomotive Repair Shops at Cape Charles, Va.

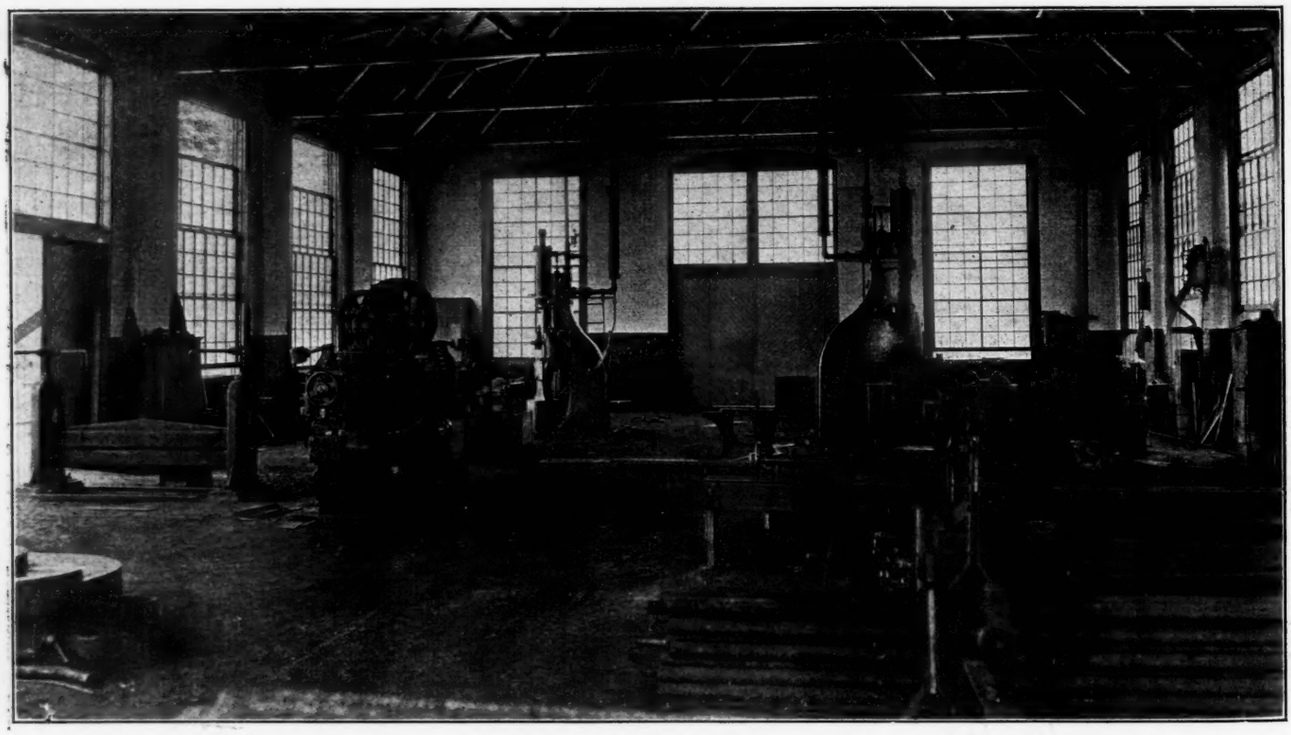
Machine and Erecting Shop; New York, Philadelphia & Norfolk, Cape Charles, Va.



Engine House; New York, Philadelphia & Norfolk, Cape Charles, Va.

The power plant is 70 ft. by 75 ft. In the boiler room are installed three 200 h. p. boilers arranged in one and one-half batteries, the boilers being hand-fired. Two fire pumps are also installed in the boiler room, each having a capacity of 500 gal. per minute; boiler feed pumps and general water service pumps are provided in duplicate. A feedwater heater is also installed. The engine room contains two 175 k. v. a., 3 phase, 60 cycle, 2,400 volt generators, driven by two 14 in. x 18 in. slide valve 225 h. p. engines. Also a 25 k. w. motor generator set and a 25 k. w. turbo-generator set for use as exciters.

The switchboard is built up of six panels of black marine finished marble. For lighting the shop and terminal yards, two 25-light, four ampere metallic flame arc lamp outfits are installed. The power plant supplies power and light for the various shop buildings, as well as light for the yards and the passenger and freight depot, offices of the superintendent and other officials which are located about a mile distant. An air compressor having a capacity of 690 cu. ft. of free air per minute is also installed in the engine room and furnishes air for various shop purposes. An hydraulic after-cooler is in-

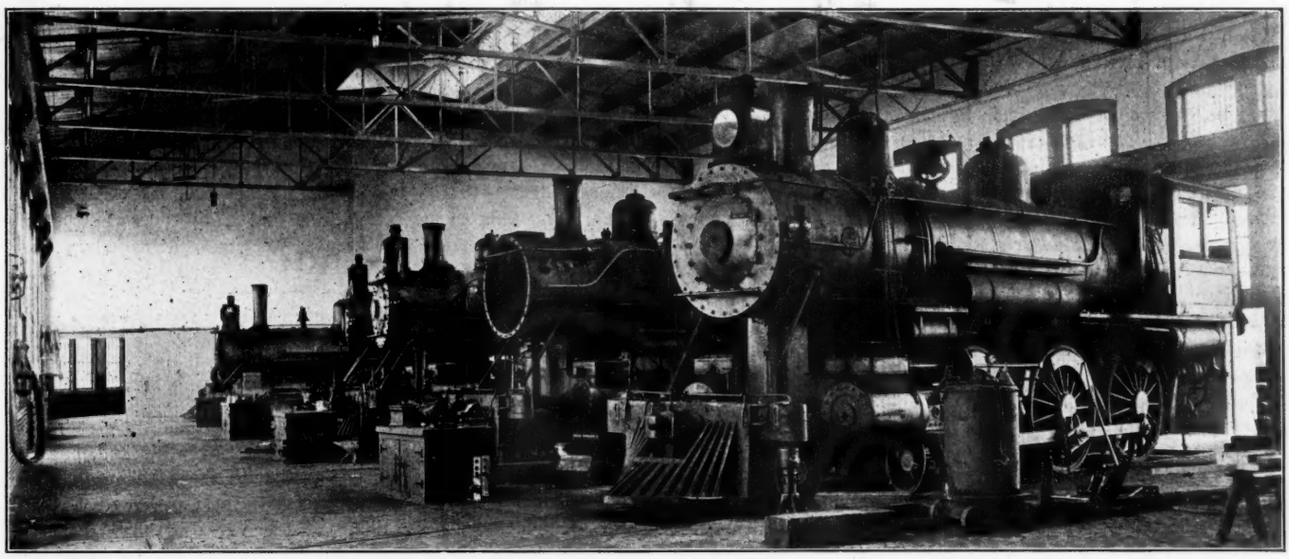


Blacksmith Shop; New York, Philadelphia & Norfolk, Cape Charles, Va.

stalled in connection with the air compressor. Provision is made for the installation of additional boilers, generators and air compressors. Also for the extension of the building proper as may be necessary.

The storehouse and office building covers an area of 50 ft. x 72 ft., and is devoted largely to the handling of material and supplies. The building contains a basement and two floors; the office of the master mechanic and shop clerk, as well as the drafting room occupy a portion of the second floor, while the remaining portion of the building is devoted to material and supplies. An electric freight elevator of 6,000 lbs. capacity has been installed. The artificial lighting throughout the building, as well as in the oilhouse and the offices of the various shop foremen, is by means of tungsten lamps; all other lighting in the buildings is furnished by type F Cooper-Hewitt lamps.

The turntable is 75 ft. in diameter, and is operated by a pneumatic turntable tractor. The ash-pit is equipped with a pneumatic hoist for the handling of ashes, and the locomotives are coaled by a clam shell bucket operated by a hoisting engine. Ample provision is made for protection from fire by a 6-in. fire main in the form of a loop surrounding the shops, which supplies the various plugs and hose reels.



Erecting Shop; New York, Philadelphia & Norfolk, Cape Charles, Va.

The water supply is obtained from 36 3-in. wells varying in depth from 26 ft. to 84 ft. From these wells the water is pumped to two 50,000 gal. steel tanks from which it is distributed through the various mains. Toilet and wash rooms have been provided with hot and cold water, and expanded metal lockers are installed throughout the shops for the comfort and convenience of the employees.

The J. W. Ferguson Company, of Paterson, N. J., erected the plant, and the various piping systems were installed by the B. F. Shaw Company, of Wilmington, Del., the plans having been prepared by R. N. Durborow, superintendent motive power of the Eastern Pennsylvania division of the Pennsylvania Railroad.

Peru in 1908 engaged the famous German firm of engineer-contractors, Arthur Koppel, to make preliminary surveys and plans for a railway from the Pacific port Paita over the Cordilleras to the Amazon. Plans and estimates for six different routes have now been submitted. The longest, costliest, but most valuable line would be 467 miles long, with eastern terminus at Melendez, on the Marañon, the cost of which is estimated at a little less than $24,000,000. Steamboats drawing 7 ft. of water may ply from Melendez to Iquitos, whence the Amazon is navigable by ocean steamers. The steepest grades on all of the routes surveyed are 158 ft. per mile.

SCIENTIFIC MANAGEMENT IN THE RAILWAY SHOP.*

BY LE ROY W. ALLISON.

Correct management has ever been a science, and scientific management is but a synonym for good management. The introduction of a system of betterment in any branch of industry is dependent upon one fundamental essential—exercising common sense; without it, system, ideals and theories notwithstanding, we are lost. These latter offer the basis of the doctrines of the good and the poor so-called efficiency engineers. The poor have sprung up in countless numbers, they are found everywhere—having a theoretical schooling, and having read a few books on the subject. Having devised a schedule of operations and ideals so based, does not constitute an efficiency engineer, or even a near one. The good efficiency man, the one who deals in a practical manner, with practical training, and endowed with an appreciation of common sense treatment is hard to find.

In the application of scientific management in the railway shop, it is a question whether the efficiency engineer be needed at all. The writer has seen him, oftentimes, doing more harm than good, and simply because of that self-infused consideration of his own importance and "know it all" ability. Each particular shop presents its individual problems, the effective solution of which lays with the practical man. No railway shop has the time for experimenting with this or with that, neither can it profitably permit of an argument of possibility; its existence and purpose demands the assurance of defined and definite intent.

Scientific management in the railway shop depends upon three things, the common sense treatment of the workman, the common sense judgment of equipment, and a mode of operation which is the outcome of a slow development and is adapted intelligently to the special requirements in the particular plant. These are listed in order of importance, and it is only through the harmonizing of the three that the desired effects may be realized.

Any system of management is directly dependent upon the workman in the shop for its success; this statement is as broad as it is true. Dealing with theories, ideals and principles, and *not* with the workman, can never result in good or scientific administration. He cannot be treated as one of a crew of nonentities, typically a human machine, seemingly lacking the

*This article was awarded the second prize of $35 in the competition on The Application of Scientific Management to a Railway Shop, which closed June 15. Mr. Allison is an engineer located at Los Angeles, Cal.

confidence of his employer, and do justice to a method for betterment. Neither can we expect a continuance of results if we initiate a square deal proposition, offering a bonus system and the like, and annul it in a short interval of time. Under such conditions it is far better to omit entirely any consideration of increased wage scale. We are not doing justice to the employe and the shop is sure to show it.

The term "co-operation and harmony" is not a new one; it is present orally and in print wherever scientific management and efficiency is mentioned; they are ever prevalent in its literature and pervade its very end. Spoken or written in the idealistic sense they mean nothing; deduced and intelligently interpreted, the expression offers the key-note to the prosperous issue of the system, all other things being equal. To gain the co-operation of the workman, are we to hand him a printed schedule of operations and the time allowed for each, or put him under a speed boss and hold a stop-watch over him? Never! At least not to the intelligent shop employe and citizen. Even though it offers a slight increase in wages, this will bring about *forced* co-operation, and this means nothing but disaster to the system, due to entire lack of interest of the workman, whose thoughts are bent and whose eyes are open for another position—a job where the driving element will not be in evidence.

When we take the workman into our confidence, reasonably explain why a certain plan of procedure is to be inaugurated, accord him a consideration for knowing something, show him how his earning capacity and ability will be increased, how both he and the railway are to benefit, then will we derive from the intelligent workman, who has the interest of the shop and road at heart, the full advantage accruing from co-operation. Harmony will necessarily follow, for one is never present without the other. To be interested in one's personal welfare is human nature; the man who is not so addicted is usually not worth very much to himself or his employer. When we give the intelligent employe common sense treatment, the method which affords him an opportunity to use his brains and does not entirely stunt his initiative, which handles him as a man and not as an animal, he is bound to recognize the square deal and reciprocate; this is directly returnable to the railway in pecuniary value.

The man to lead and direct is directly responsible to the railway for the effectiveness of his department. In scientific management such a man must be a real leader, a practical man with enough theory to discern the distinction; he must have the ability to show and direct concisely; and, above all, must understand the failings and weaknesses of his men. Such a man will have seen service continued and varied, in his particular line—not from college, or books, or looking on, but from actual work in the shop. This is the class of men who can obtain co-operation and harmony from their men by the simple application of common sense. The impractical and theoretical man, with his system, when chosen to direct the practical workman is almost inevitably a failure, and the direct cause is not difficult to find—he forgets to include common sense.

Shop equipment should, of course, be of such design and quality as will offer the most efficient results and service. Placing a poor tool in the hands of a good workman is as much a wrong as giving a good tool to one who is not proficient—in neither case do we attain results. The selection of a tool, or tools, requires the ability of one who knows machinery, and whose knowledge of the shop's requirements is accurate. In standard equipment, such as lathes, planers and the like, the numerous manufacturers' announcement, place each individual product as "the best." This cannot be; there can be but one *best* for each particular class of work, and the railway shop must select accordingly. The necessity of good equipment in scientific management is of equal importance to the employment of competent workmen.

The usual costliness of the installation of a system of scientific management in a railway shop demands that the principles involved should be thoroughly practical, tried out, and correctly interpreted. They must be based upon fact, sound and liberal, and warranting a just return for the expenditure of time and money. The system must be made to conform to the shop, never the shop to the system; it must be one for the betterment of existing conditions, as found, and not a method which is to demolish with a blow that which has taken brains and years to perfect. Established precepts cannot be discarded for illusory ideals which *may* be attained, without a full research as to their worth and fitness. In justice to the shop, the employes and itself, the railway cannot neglect practical and common sense effort; consideration must be given as to *why* and the reason therefor, otherwise a confused and tangled mass will result which will prove disastrous.

The writer has often seen and heard the phrase, "fit the man to the plan"; it means little more than making a dog do tricks. "Fit the man and fit the plan" is more sensible; both require fitting and often the latter is the hardest and more difficult to cut to shape. The definite standards of operation must be derived from the shop in question from actual work and the full investigation thereof; results can never be attained from "what it ought to be," based upon a foreign plant or theory—this may be suited to the library and book-shelf but not to the railway shop.

In an age of industrial betterment it is easy to become inoculated with the efficiency germ. Scientific management should spell economy, an increased output with decreased cost, but such decrease never by a reduction in wages. The ultimate outcome is assured if we administer and are governed by the laws of common sense—to the workman, his welfare and wage scale; to the shop equipment, its aptitude and quality; to the system, its suitableness and recompense to the railway shop and employe.

WALSCHAERT VALVE GEAR BREAKDOWNS.*

The handling of the Walschaert gear in the event of a breakdown, presents no special difficulties. It is usually desirable, if possible, to take down both the eccentric rod and main rod. The crosshead and valve stem can then be securely blocked, exactly as in the case of an engine equipped with the Stephenson gear. The radius rod should be disconnected from the reverse shaft by removing the lifting link. If the valve is blocked in its middle position the cylinder on the damaged side will be cut out.

If the main rod, crosshead and piston on the damaged side are in a condition to run, the main rod may be left up, provided there are relief valves in the cylinder heads. The relief valves should be removed, so that the cylinder can be lubricated and excessive compression be avoided. With the eccentric rod down, and the valve securely blocked in its middle position, the engine can be run with the other side. It is of course necessary, in this case, to remove the crosshead link, and fasten the combining lever in the forward position. The foot of the lever can readily be secured to one of the cylinder cocks by a stout cord or wire.

If the damage is confined to the eccentric crank or rod, or to the lower end of the link, and the latter is still supported on its trunnions, the main rod may be left up, and the valve may be operated by the combining lever. To accomplish this, take down the eccentric rod, disconnect the radius rod from the reverse shaft, and secure the link-block exactly at the center of the link. The maximum port opening on the damaged side will now be equal to the lead, and the cut-off will be very short; but the steam will do at least some work, and the engine can be reversed and both the cylinders will be lubricated.

*From Record No. 70, published by the Baldwin Locomotive Works, Philadelphia, Pa., and entitled "Walschaerts Valve Gear."

ENGINE HOUSE KINKS; PENNSYLVANIA RAILROAD.

BY C. C. LEECH,
Foreman, Buffalo, N. Y.

OIL HOUSE.

A compact and convenient arrangement of handling the different kinds of oil required for locomotives is shown on the accompanying drawings, Figs. 1 and 2. To economize space, a cellar was excavated alongside the engine house, but the tanks can be housed in a building above ground if desired. The arrangement of the tanks is clearly shown on the drawings. Where two tanks are filled with the same kind of oil, they are connected by pipes. The arrangement for filling the tanks is clearly shown in one of the illustrations, section *C, D*. The

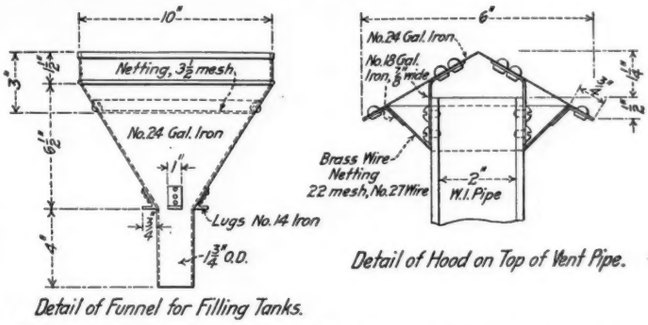
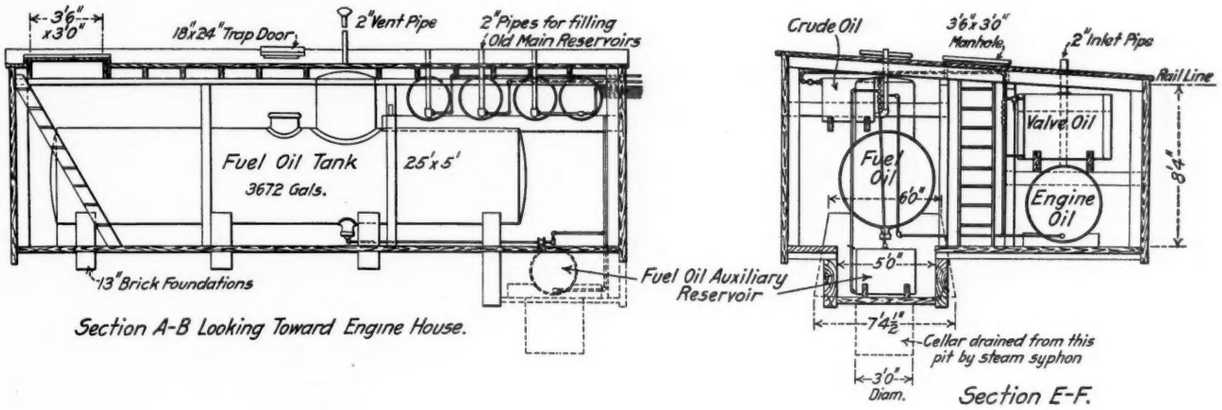
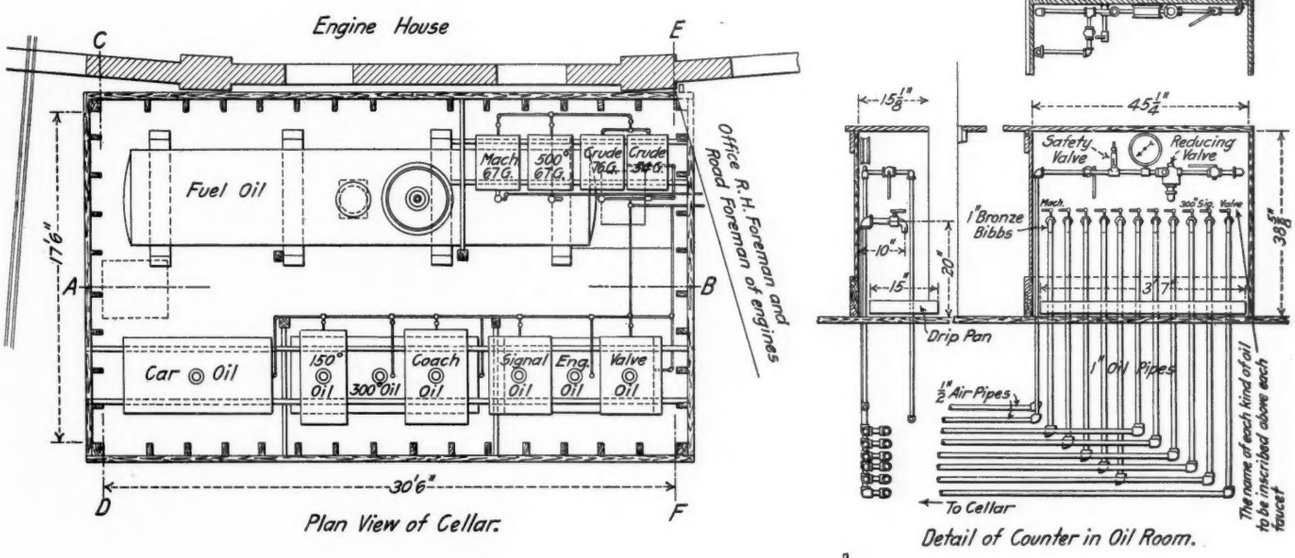


Fig. 2—Funnel for Filling Oil Tanks, and Hood at Top of Vent Pipe.





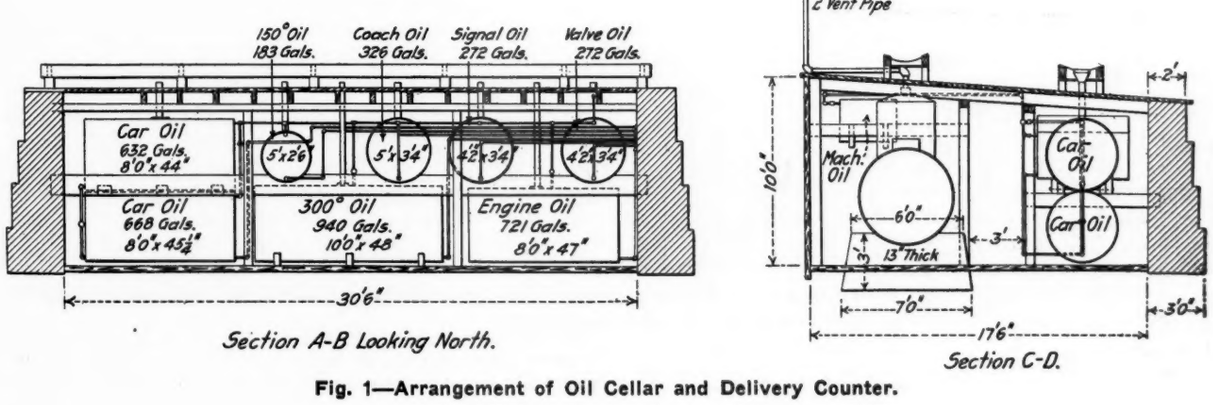


Fig. 1—Arrangement of Oil Cellar and Delivery Counter.

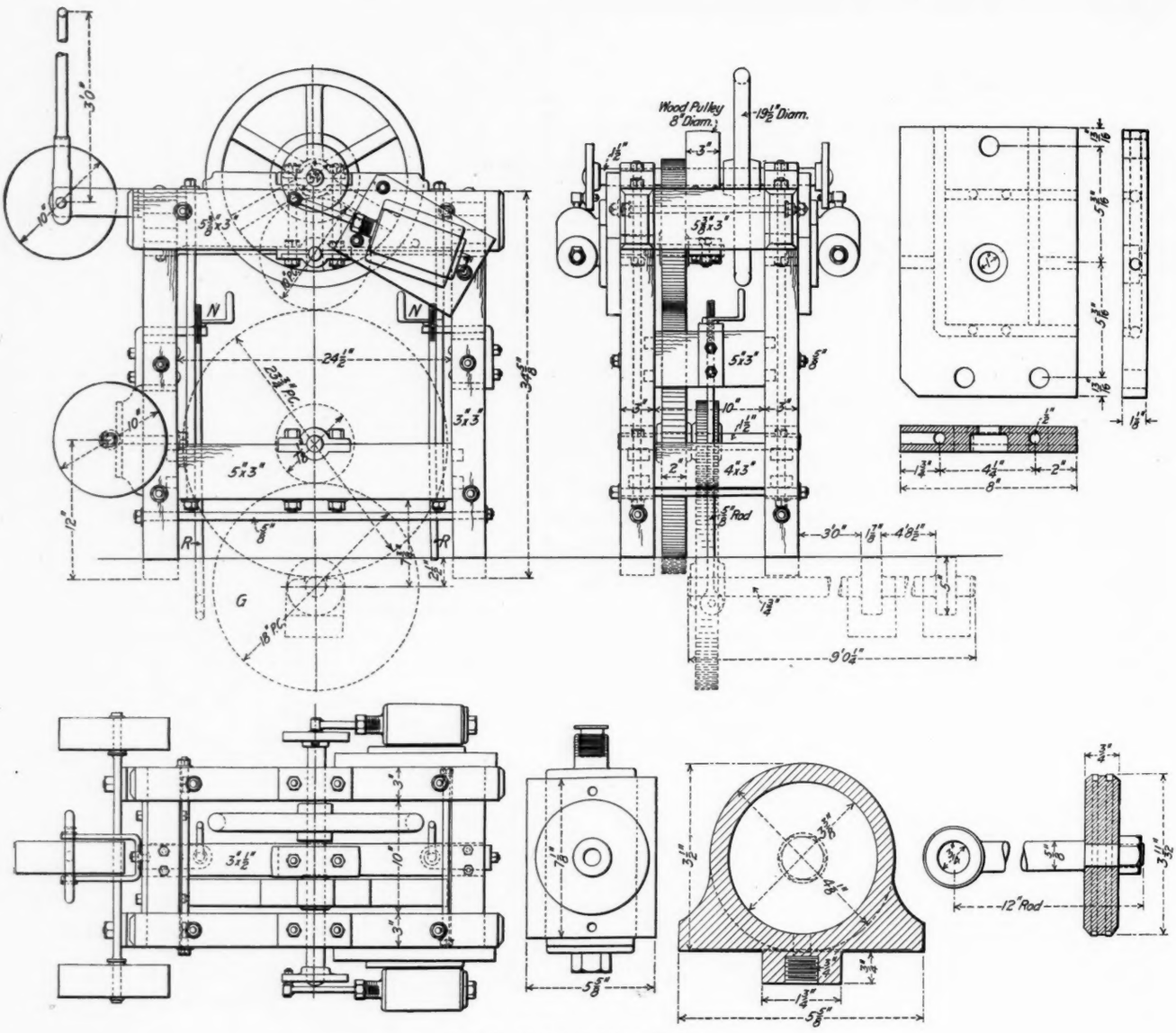


Fig. 3—Valve Setting Machine.

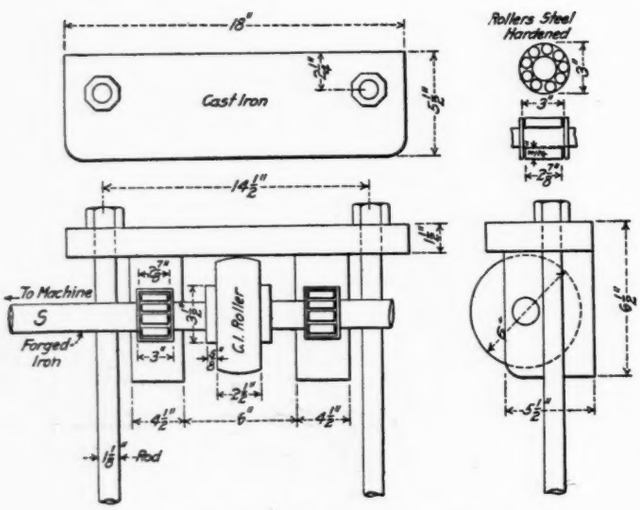


Fig. 4—Rollers for Valve Setting Machine.

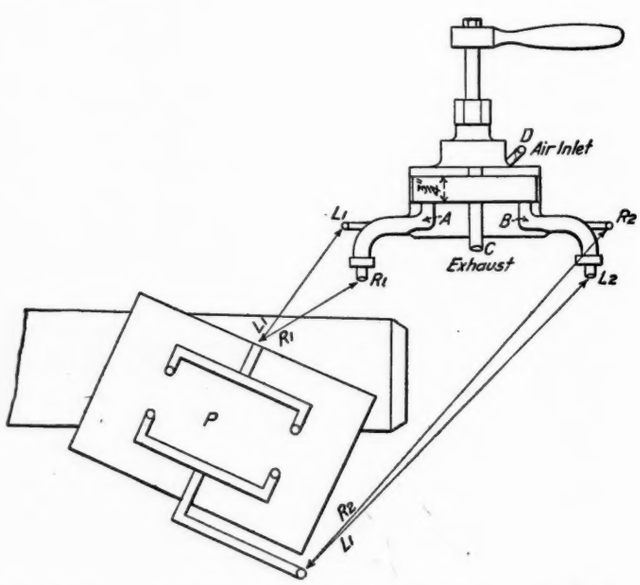


Fig. 5—Four-way Valve and Method of Piping It to Cylinders.

funnel is placed in the top of the inlet pipe after the cap has been removed and the oil barrel is rolled out on the runway or skids, and placed so that the bung in the barrel is directly over the funnel. Air pressure is, of course, shut off from the oil tank while it is being filled. A reducing valve in the air supply line reduces the pressure in the oil tanks to 25 lbs. per sq. in. One of the illustrations shows a detail of the oil pipes and faucets at the delivery counter, which is inside of

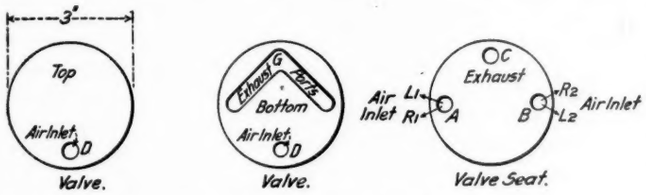


Fig. 6—Arrangement of Valve and Valve Seat for Oscillating Cylinders.

The frame of the valve setting machine shown in Fig. 3 is of attendant without moving from his position.

VALVE SETTING MACHINE.

The frame of the valve setting machine shown in Fig. 3 is of wood, well bolted together. The oscillating cylinders by which it is operated are of brass. The journal boxes are of cast iron, with babbitted bearings. A small pulley is placed on the driving shaft so that in an emergency the device may be utilized for driving one or two of the machines in the machine shop of the engine house. The machine is fastened rigidly in place alongside the locomotive, whose valves are to be set, by means of the two rods, *R*, which hook into eyebolts, which are let into the floor; the rods may be adjusted and tightened by means of the two handle nuts, *N*. It is, of course, necessary to have these eyebolts in the floor alongside each of the pits in the engine house, preferably at the right hand side. The four cast iron boxes, one of which is shown in detail in Fig. 4, are placed in position on the rails with the cast iron rollers resting against the tread of the driving wheel tires. Each set of boxes is tied together by the 1⅛-in. rods, the nuts on these rods being drawn up tightly enough to lift the main driving wheels off the rails, thus allowing the weight to be carried on the rollers. The shafts carrying the rollers revolve in the roller bearings in the cast iron boxes. The rollers are located on the shafts at points which correspond to the distance from the center to center of the wheel treads. One of the shafts is extended out far enough to allow a gear at its end to engage with the train of gears on the machine. In this way the driving wheel may be revolved at will.

Details of the four-way air valve and the method of piping it to the cylinders are shown in Fig. 5. The cylinders are of the oscillating type, and are secured to the plates, *P*, by a center stud, the faces of the cylinders and plates being first carefully faced and ground to a bearing. The arrangement of the valves and ports, and also the valve seat, is shown in Fig. 6. The arrangement of the piping shown in Fig. 5, of course, only shows one side, the left hand in this case, but the arrows *R*1, and *R*2, indicate the piping of the right side. The upper air ports of each cylinder plate are both piped to the *A* side of the valve, while the lower ports are piped to the *B* side. Therefore when air is admitted to the valve at *D* and the valve is turned so that the port *D* (Fig. 6) in the valves is directly over the corresponding port *A* in the valve seat, air passes into the cylinders through pipes *L*1 and *R*1 and the top ports in the plates, and is exhausted through the lower ports *R*2 and *L*2

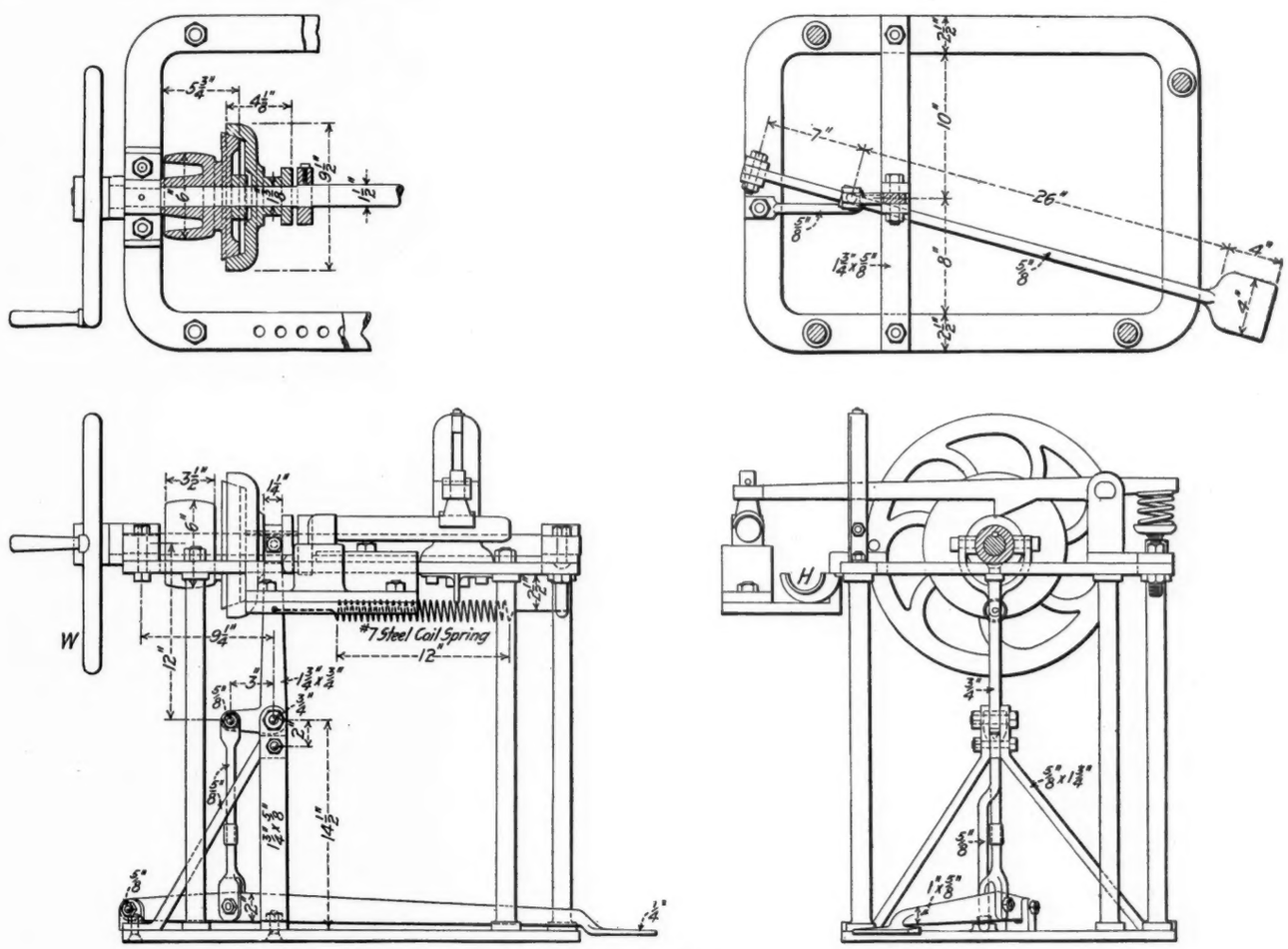


Fig. 7—Tube Welding Machine Arranged for Power Drive.

up through the port *B* in the valve seat and through the exhaust cavity *G* in the underside of the valve, and then on to the atmosphere through the exhaust *C* in the valve body. Reverse motion is obtained by moving the handle of the valve to the opposite side and sending the air through the pipes *R2* and *L2* and exhausting out through *L1* and *R1*.

At one side of the machine are three wheels, near one of which is a handle. When it is desired to move the machine about the engine house, it is tipped over so that it is supported by these wheels and may then be moved about with ease.

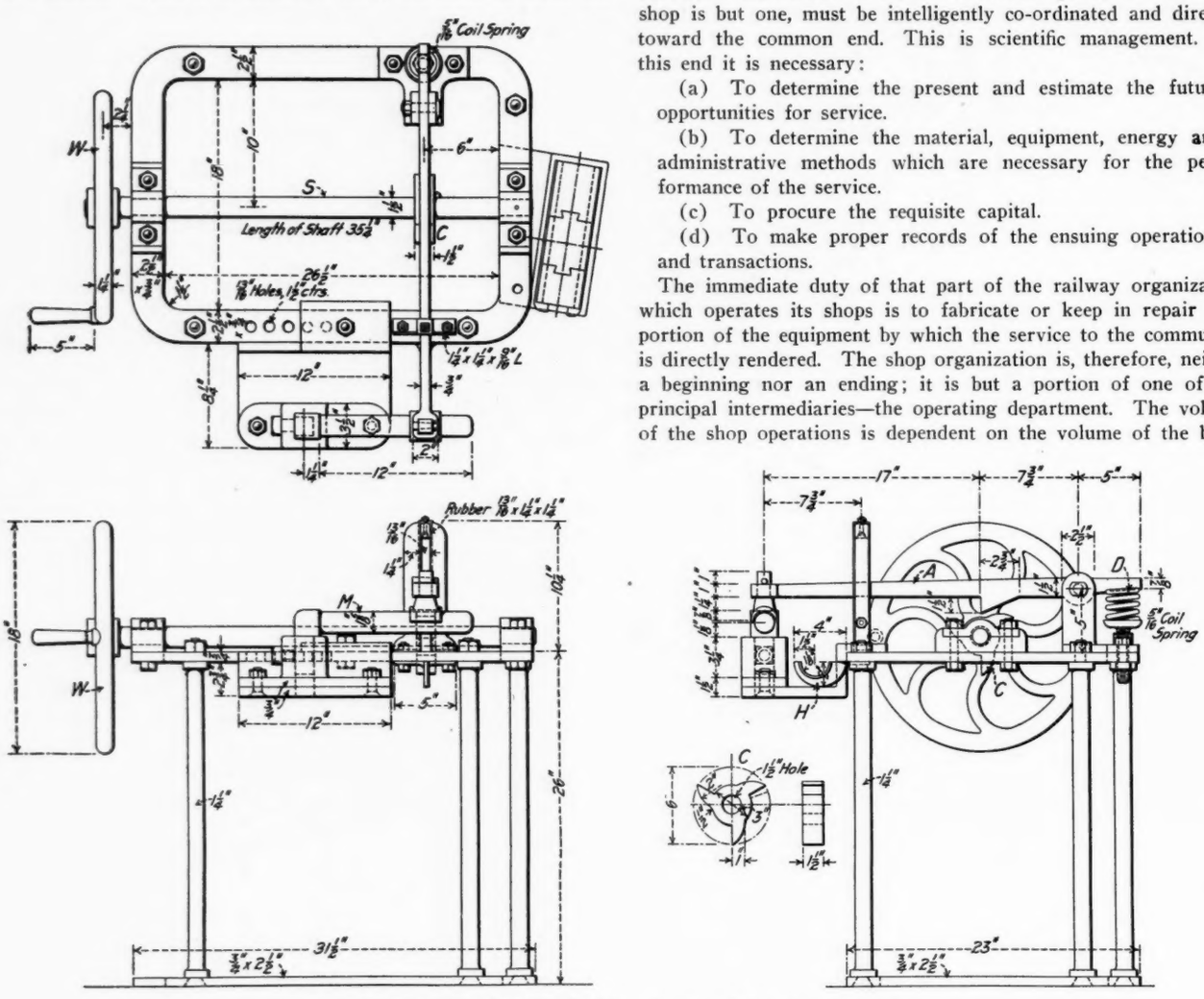


Fig. 8—Tube Welding Machine Arranged for Hand Power.

TUBE WELDING MACHINE.

Where power cannot be had for operating a tube welding machine in the engine house, the device shown in Fig. 8 may be used to good advantage, and it requires only a blacksmith and a helper to operate it. The framework of the machine is made of ¾-in. x 2½-in. bar iron, which is supported on four posts of 1¼-in. round iron. The machine is operated by turning the hand wheel *W*, which is keyed to the shaft *S* on which a three-toothed cam *C* is fastened. As this cam is revolved, the arm *A*, which rests on it is raised and lowered rapidly. The force of the striking movement is controlled by the coiled spring, *D*, which may be adjusted by means of the screw and nuts. The left-hand end of the arm, *A*, is fitted with dies for welding the tube or for other purposes. Where power is available, this tool may be improved by the application of a pulley and a clutch mechanism for operating it, as shown in Fig. 7. The knife or hook *H* is for scraping the scale off the tube or safe end before welding.

THE APPLICATION OF SCIENTIFIC MANAGEMENT TO A RAILWAY SHOP.

BY H. F. STIMPSON.*

The object of any legitimate organized enterprise is to serve beneficially the entire community. A railway company is an instance of such an effort. In order that the effort may be successful the efforts of all its constituent parts, of which the shop is but one, must be intelligently co-ordinated and directed toward the common end. This is scientific management. To this end it is necessary:

(a) To determine the present and estimate the future opportunities for service.

(b) To determine the material, equipment, energy and administrative methods which are necessary for the performance of the service.

(c) To procure the requisite capital.

(d) To make proper records of the ensuing operations and transactions.

The immediate duty of that part of the railway organization which operates its shops is to fabricate or keep in repair that portion of the equipment by which the service to the community is directly rendered. The shop organization is, therefore, neither a beginning nor an ending; it is but a portion of one of the principal intermediaries—the operating department. The volume of the shop operations is dependent on the volume of the business developed by the traffic department, and is largely affected by the efficiency with which the train crews, etc., handle the equipment with which they are entrusted. The resources at the command of the shop organization are derived from the financial department and are also largely affected by the efficiency with which the operating equipment is handled.

The shop organization, therefore, is not and cannot be considered as a separate entity. This must be taken into account in considering any question of shop management. In any line of reasoning we must have a starting point. The position which the community, through its Interstate Commerce Commission, has recently assumed regarding an increase of rates, goes to show that the present, or lower, instead of the higher rates must be taken as being such a point. While the charge against new construction is a charge against capital account, the interest on this as well as the cost of repairs on both transportation and shop equipment becomes an overhead charge on the direct cost of transportation. If then the rates are fixed, it is desirable that

*Chief Engineer, Universal Audit Company of New York. This article was entered in the competition on the application of scientific management to a railway shop, which closed June 15.

both the amount and cost of all shop operations be reduced to the lowest possible terms in order to reduce the overhead charge on the direct cost of transportation.

Any waste here or in any other contingent operations will either increase the cost or decrease the quantity or quality of the service rendered to the community, of which each of the workers is a part, whereas the attainment of a high state of efficiency should result in a decrease in cost or an increase of the quantity or quality of the service, thus benefitting the community. The interests of the community as a whole, of the stockholders as such, and of the workers as such are, therefore, identical. If the operation of the railway results in over or under protection to any of these interests, it will be because either the industrial or commercial management has been inadequate. If the industrial management has failed, the actual cost of production will be found to have been unduly increased. If the commercial management has failed, the profits will be found to have been improperly divided between worker, stockholder and community.

Because the shop organization is, as has been said, neither a beginning nor an ending, but simply a part of an intermediary, it is as unwise to attempt the immediate and exclusive application of the principles of scientific management to such organization as it would be to develop one leg of a horse. We must consider both the things which precede and the things which follow its operations. For instance; I was told, with much pride, by a shop manager of the number of locomotives which came out of his shop each month. This was not of much importance. The important thing was the *time which each locomotive had been withdrawn from service.* I was perfectly convinced from what I saw, being accustomed to observe such things and to draw correct deductions therefrom, that, if a chart had been made showing the chronological durations and relations of the actual operations performed, it would have been found that not only were there large wastes of time in the performance of the individual operations, but between them. Not the least evidence of this condition was the difficulty the executives had in comprehending the possibility of such a thing. They were not interested in searching for a remedy for a disease which they did not believe existed. Here we have a diminution of earning power co-existent with the increased cost of repairs, both of which add to the overhead charge, thus burning the candle at both ends.

To arrive at correct conclusions, we must first have complete and accurate statements as to what should have and could have taken place (*standards*), as well as of what has taken place (*records*). Liberal expenditures of both time and money are necessary in order to obtain these, but these expenditures are insignificant when compared with the savings which should result from their use.

Taking the maintenance side of the question, the first step should be to separate the process of deterioration of the direct operating equipment into the preventable and the unpreventable factors; second, to determine the actual and necessary rate of each; third, the causes of each; fourth, the remedies for each so far as possible. We have now determined the necessary gross rate and volume of repair work which should come into the shop. From an analysis of this we can determine the unit operations together with the material, equipment and energy and administrative methods which are necessary for their performance. Scientific management, so far as the shop is concerned, is the process of properly supplying these essentials and of directing their use.

The first essential is material. Certain material is fairly standard as to quality and the rate of consumption. Other material is more irregular in both respects. In either case, as the result of the above analysis, the exact date of delivery to the shop can be and should be fixed both specifically and in detail by a person who is in a position to grasp the entire chain of operations in which the one involving the use of any bit of material is but a link. While this work is often delegated to or attempted by a foreman or other person immediately engaged in the performance of manual operations, it is evident that such a course is illogical. Not only is the foreman unable to grasp correctly the entire situation, but the ill effects of any erroneous sequence which he establishes will be felt throughout the entire organization.

Having been given the desired date of delivery to the shop, the storekeeper should set a date for delivery to himself which is sufficiently in advance to admit of the necessary examination, checking up and redelivery. The order should then go to the purchasing agent. Having been instructed as to the quality of the commodities and the date at which they must be delivered to the storekeeper, the only variables in the operations of the purchasing agent are price and time. It should be possible to establish his efficiency upon the basis of a compound unit composed of dollars and days. Thus a high price would be compensated for by the saving in the productive time of the operating unit, which could be effected by a quick repair resulting from a quick delivery.

The next essential is the equipment by which the material is fashioned, or the work performed. Equipment represents a capital investment upon which interest and depreciation must be earned. It is therefore desirable to use the smallest possible quantity by which, when operated to its fullest legitimate capacity, the desired amount of work can be produced. This condition is not often as closely approached as should be the case. Here again we must use compound units to measure results. The cost of interest and depreciation on the machine, the time of operation and the cost of power must all be taken into account. It is conceivable that a quick acting machine might be so costly to maintain and to drive as to be far excelled by a slower machine which besides being far cheaper took less power to drive. Details of past accomplishments and the opinions of men and foremen in such matters are extremely unsafe and unsatisfactory as guides when contrasted with the cool scientific analysis of the efficiency engineer of the results which it is mechanically possible to achieve. There is, furthermore, a curious tendency to do things by halves, to utilize highly developed mechanical energy and appliances for a part of an operation and the crudest kind of methods for the rest. I have seen, in a railway shop, a highly developed press for forming boiler heads, operated by hydraulic pressure. The controlling valves, instead of being operated by mechanical energy through a secondary system of cylinders and pistons, were operated by human physical energy, applied slowly and painfully through levers. The same thing was true of the work of prying the heads from the dies where they often stuck. Boiler sheets were lifted and lowered over the jaw of a riveter by an expensive crane which was needlessly tied up on the job. The crane should have transferred its burden to a stationary hoist. Man, at a slow rate of speed, rotated the shell when rivetting the transverse seams. A vertical, power driven drum, cable-connected to the shell, should have done the trick more cheaply and quickly. These wastes clearly demonstrate the fallacy of depending on men immediately engaged in the direction of manual or mechanical operations for the evolution of operative methods.

The third essential is energy, of which there are two types—physical, which may be either of mechanical, animal or human origin; and mental, which is of both superhuman and human origin, the latter variety alone being under consideration at present. Human physical energy is essential to the control of either mechanical or animal energy. Human mental energy is essential to the direction of all types of physical energy.

Working back from the equipment, on one side we find in series, the tool, the generator, the engine, the boiler and the coal, which is one of the chief sources, terrestrially speaking, of mechanically energy. The boiler, engine, generator and motor are only the means whereby the latent energy in the coal is transformed, transmitted and applied to the tool. Controlling the tool we find the body of the man actuated by his mind which is his motor. Working back from the mind of the man, we find

that it is at the end of a series composed of the minds of the foremen, superintendents, general manager, president, executive committee, board of directors and stockholders. The wish in the minds of the stockholders that a railway shall be operated for the purpose of making money is the real latent energy which, transformed and transmitted through the whole human organization finally reaches and is applied to the mind of the worker and causes him, by means of his physical energy, to put the mechanical energy into operation. If the various appliances by which the energy in the coal is transmitted to the tool are not suited to the end in view or are not properly connected, the result will be disappointing. It is even more true in the human machine or organization that there must be a sufficiency of adequate mind units, properly connected, to insure satisfactory results. A motor cannot be energized through a lightning rod by occasional flashes of lightning. It must receive a continuous supply through proper connections from an adequate generator backed by coal of high thermal qualities. Similarly a man must receive a continuous supply of mental energy through a proper organization from a competent executive backed by energetic stockholders.

As we have seen, the railway shop is but a part of one of the principal divisions of a railway organization. In a well-designed power plant there must be a principal steam drum main into which all the boilers discharge and from which all engines draw the necessary steam. This steam drum may be compared to the chief executive officer. The title of president, usually employed, is incorrect, being purely parliamentary and not executive in its nature. A better term would be general manager, as expressing universal control of the operating organization. The departmental managers, which are the heads of the principal divisions, may be compared to the generating sets by which the energy, focused in the general manager, is applied to the various phases of the business.

In a power plant, however, but little in the nature of a refining operation, except a certain amount of drying, is applied to the steam in the drum. In the case of the human steam it is different. The increase in the volume of ascertained fact, in recent years especially, has been so rapid that it is physically and mentally impossible for the general manager of a great railway or other industrial enterprise to acquire a complete acquaintance with that which pertains to his line of work. To overcome this difficulty, two general methods have been pursued, sometimes separately and sometimes in combination. The first method is to require each member of the organization to absorb such new information as pertains to his particular work. This is not advisable because it requires a man to carry on, simultaneously, two radically different lines of thought which require different conditions and equipment for their operation. Productive and investigative operations cannot be conducted at one and the same time with mutual advantage. The second method is to attach certain specialists, or energizers, to various parts of the organization to perform the investigative portion of the work. This is an improvement, but it fails of entire success because the effect of this disjointed advice on the other divisions of the organization has not and cannot be properly digested in advance of its application. It is only when these specialists are entirely withdrawn from the operating organization and separated into sections corresponding to the divisions above alluded to, and put directly under the control of the general manager that success will attend their efforts.

When, therefore, mental energy in the form of a direction or standard practice instruction is to be applied, it will have been considered from every possible standpoint; it will have received the final consideration of the chief executive, as to generalities, and may be fairly depended upon to produce the desired results.

In applying this theory the result would be the gradual withdrawal of the more able men from the directly operative work to the advisory work, their abilities being replaced by carefully prepared instructions. This would open up a line of promotion to the operating men which does not now exist. The result would be a development of workers, first into the administrative positions under carefully formulated instructions, and finally into positions on the staff which formulates these instructions. The expense of maintaining this staff would not be by any means an entire addition to the present operating cost, for most of the men are, at present, doing such work, but in the wrong place and under the wrong directions. Any additional cost which ought to eventuate would be many times regained from the increased efficiency of the great army of workers.

The fourth essential is the administrative methods by which proper directions for the utilization of material, equipment and energy are transmitted to the various units of which the organization is composed, and proper records are secured as to the results obtained. Both of these things are equally necessary for the comparisons which are essential to the successful control of any business.

The line of the outward flow of the directions must be carefully determined, in great detail, so that all units will receive their proper share of the directions in the proper sequence. The experience necessary to lay down these lines is, contrary to the common belief, quite distinct from that necessary to pass upon the subject matter of the directions. The phases of all such directions are much alike, as are the principal phases of all organizations. This is almost incomprehensible to those whose chief study has been that of the subject matter, but it is nevertheless true. The specialist in this work, therefore, finds much less difficulty in devising a proper routine for almost any business than the specialist in any one line would find in devising a routine for the business with which he is most familiar. The two lines of work are separate. The machinist can make a better typewriting machine than can the stenographer; though, being unable to compose the letters which are to be written upon it, he is unable to operate the machine to advantage after its completion. This the stenographer can do even though he is unable to construct the machine itself.

The line of inward flow of the records must carefully parallel that of the outward flow of the standards. The maxim should be a standard for and a record of every operation. Because frantic attempts have been made to deduce information from records alone, which it is impossible to get except from a comparison of records with standards, most concerns are loaded up with a vast amount of unproductive bookkeeping. It is quite possible to gather, at a large expense, masses of figures which never become of the slightest use, and to leave ungathered much data which is of extreme value. Hence the correct correlation of standards and records is of the highest importance.

Both standards and records, however, fail to be of use unless diligently studied by the various members of the organization, especially the chief executives. Of what use would be the most careful observations and plotting by the navigators of a ship if the captain did not digest the information and act accordingly? When the information has been put into proper form, the work of using it has not been even begun. For this reason the data should reach each administrator in such shape that only the problems suited to his rank will be presented to him for his solution, thus economizing his energy.

In closing this very brief discussion of the principles which should guide the application of scientific management to the railway shop and also, as is absolutely essential, to the entire organization, a word may be in order as to the characteristics of the efficiency engineer and the part which he should play. Such an engineer should be a corporation, or other aggregation of individuals, co-ordinated under a competent head and having among its members individuals able to advise in every form of *administrative* detail, both commercial, disciplinary and technical. No single individual can possibly have acquired the necessary breadth of experience which is necessary in order to properly handle directly all the detail of this work. Such an engineer should not under any consideration, attempt to do constructive work with his own men. He may and should employ such men for his investigations, which should be impartial and unprejudiced.

He should lay down the entire form of the organization by offices, leaving the railway officials to fill them. He should revise the present routine and the forms which insure its operation, and make such specific recommendations as are necessary to bring about the desired condition. He should suggest the order of changes and promotions, but not pass upon the ability of the individuals to be affected by them. He should, directly or through trusted subordinates, give such explanations of new methods as are necessary for the proper understanding thereof, to any individual needing them. He should conduct such a process of friendly inspection, from the president down, as will determine, until the natural checks get into full operation, that the administrative operations are being properly performed.

This work will take several years in any railway for its accomplishment. Large results will not be seen immediately. Only patient and persistent effort and honest co-operation from all concerned will eventually produce them. Given these things, the results are sure to follow.

SHOP KINKS; NEW YORK, SUSQUEHANNA & WESTERN.

BY W. H. SNYDER.

Assistant General Foreman, Stroudsburg, Pa.

TWISTING ECCENTRIC BLADES.

A convenient device for twisting eccentric blades is shown in Fig. 1. The two hooks are placed on the eccentric blade

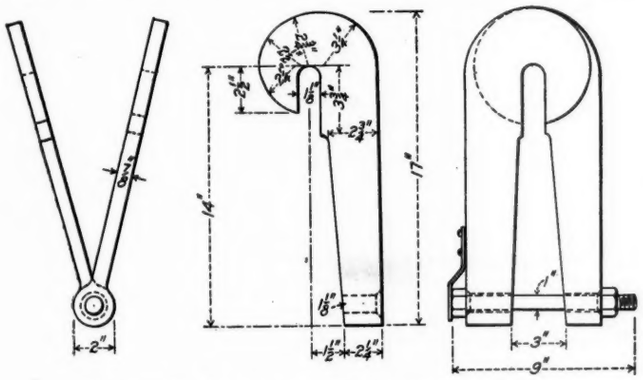


Fig. 1—Device for Twisting Eccentric Blades.

from opposite sides and it may then be twisted the desired amount by tightening the nut on the 1-in. bolt which passes through the ends or tails of the hooks.

UNIVERSAL OLD MAN.

A universal old man, useful for drilling purposes, is shown in Fig. 2. The base *A* may be removed from the upright by

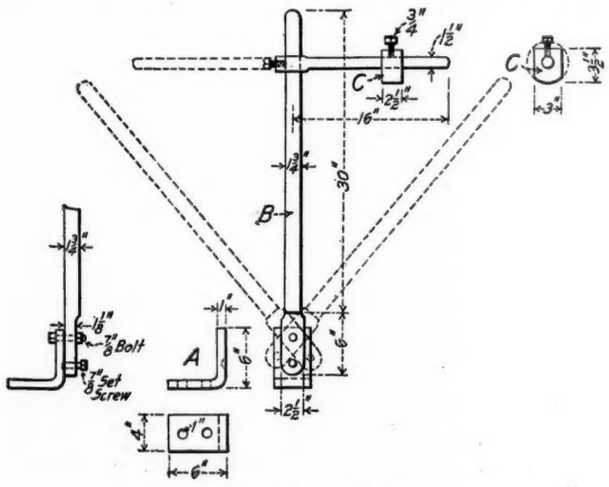


Fig. 2—Universal Old Man.

taking out the ⅞-in. bolt; it is thus convenient where an old man with a solid foot cannot be used. The ⅞-in. set screw at the bottom of the upright prevents the post from twisting on the base after it has been properly set. The block *C*, which is grooved or serrated lengthwise, does away with the necessity of punching the arm with centers and the device is universal in every respect.

MANDREL FOR TURNING TIRES.

The mandrel for turning tires, which is shown in Fig. 3, was made from an old pair of driving wheel centers which were taken from the scrap pile and were mounted on a scrap axle.

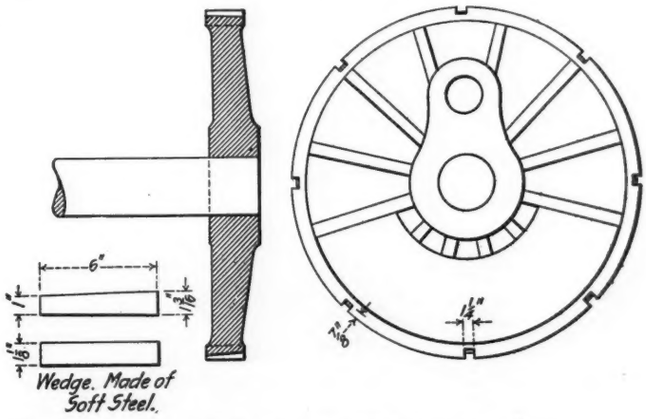


Fig. 3—Mandrel for Turning Driving Wheel Tires.

They were turned down about ⅛ in. smaller in diameter than the bore of a 48-in. tire and the edges were slotted, as shown, the taper of these slots being ⅜ in. to 1 ft. The wedges are driven from the outside and a pair of tires can be properly mounted on the mandrel for turning, or be removed from it, in a comparatively short time. The wedges do not have to be drawn up very tight in order to hold the tire securely. A

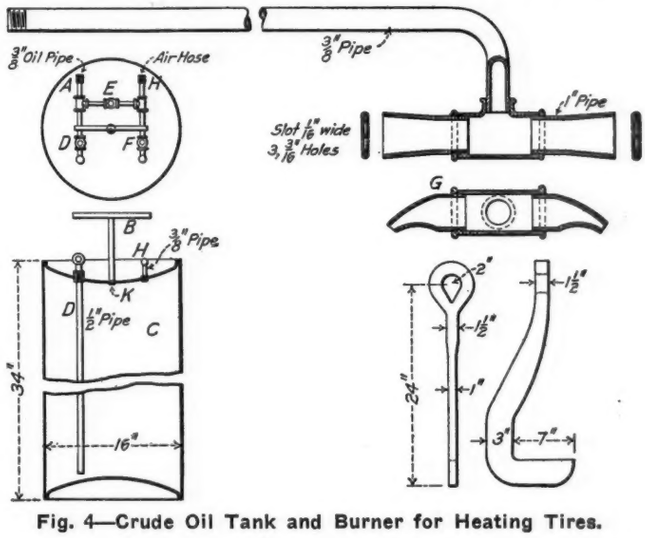


Fig. 4—Crude Oil Tank and Burner for Heating Tires.

mandrel of this kind is not only useful for turning old tires which have been removed from a heavy class of engine, but are thick enough to be used on a lighter engine, but they may also be used to splendid advantage where standard wheel centers are used and the finished tires are carried in stock at the engine houses and are exchanged for worn tires, which are sent to the shop for re-turning.

TIRE HEATING APPARATUS.

The tire heating apparatus shown in Figs. 4 and 5 is not only convenient, but is economical in the use of fuel. It uses the cheapest grade of fuel oil, about 12 gals. being re-

quired to remove a set of six 48-in. tires 1⅞ in. thick, and 25 gals. to apply new tires 3 in. thick. At three cents a gallon the cost of the 37 gals. of fuel oil would therefore be $1.11. Prior to the introduction of this apparatus, about 18 gals. of kerosene were required for removing a set of similar tires and 45 gals. for the application of new tires. At 10 cents a gal. the cost of kerosene was $6.30, or $5.19 greater than the cost of the fuel oil. By removing the handle *B* in the top of the tank *C*, shown in Fig. 4, the tank may be filled with oil through the hole *K*. When the handle has been reapplied, the air hose is connected to the pipe *H*. The burner *G* is connected to the ⅜-in. oil pipe at *A*. Air is admitted to the top of the oil tank through the pipe *H* and the valve *F* and the pressure forces the oil out through the pipe *D*, which extends to within 1½ in. of the bottom of the tank. The flow of oil is regulated by the globe valve *D* and the flow of the air which mixes with it by the valve *E*. Valve *F* is always left open when the apparatus is in use.

The hook shown at the right in the same illustration is used for supporting the tire as it is hoisted by the one-half ton chain hoist. Directly back of the tire in Fig. 5 and near the

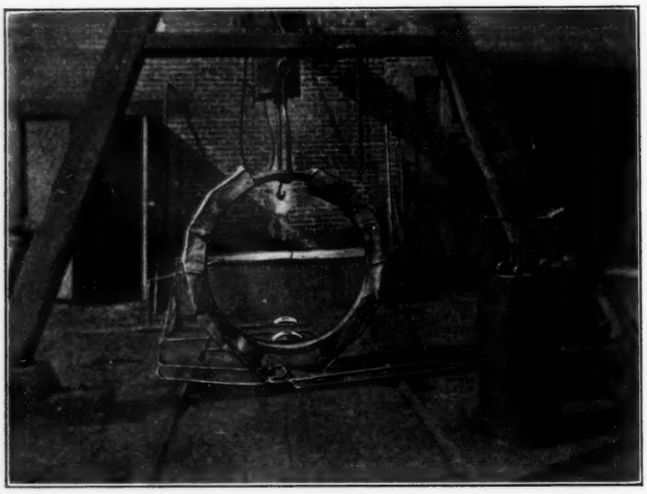


Fig. 5—Apparatus for Heating and Mounting Driving Wheel Tires.

center of the track may be seen two castings, which are securely bolted to the planks. Two pedestals, which are indistinctly shown leaning against the uprights of the large trestle, are placed in these castings, or bases, and the wheels are lifted by the air hoist shown in the back ground, the axle being placed on top of the pedestals. The pedestals are high enough so that the bottom of the wheel is some distance above the ground and in a convenient position for applying the tire after it is heated. Both the air and the chain hoists are suspended from trolleys, so that the wheels and tires may be handled easily and conveniently. The hoods, which are placed about the tire while it is being heated, are made of ⅛-in. boiler steel and are supported by frames, constructed of ⅜-in. x 1¼-in. iron, so that they may easily be pulled away from the tire when it has been properly heated.

A Havre firm sued the Western (State) Railway for damages, which it set at $80,000, because the railway did not deliver sundry carloads of freight until after the time prescribed by law. The state pleaded *force majeure*, which includes what our law calls "act of God." There was a strike on the railway and on the docks; there was an inundation; there was more freight than they could handle anyhow. But the court held that this did not excuse the railway, and it sent the parties to an arbitrator to estimate the actual damages.

APPLICATION OF SCIENTIFIC MANAGEMENT TO A RAILWAY SHOP.

BY C. J. MORRISON.*

Scientific management, which has so recently become a popular by-word, is a misnomer. The average interpretation placed upon the term is that it describes a certain system of management, whereas in reality it does not refer to specific methods but to basic principles of intensive production. The application of these principles to any business does not necessarily mean a thorough revolution of all existing methods and practices, as one would infer from the generally accepted description of scientific management. Changes in methods, however, may follow the application of these principles which direct the way toward maximum output at minimum cost. Briefly enumerated these principles are:

Establishment of an equitable standard for measuring the quantity and cost of output.

Continuous record of accurate and reliable production data.

Full knowledge and thorough analysis of all details.

The business of a railway is manufacturing and selling transportation and the problem is, wherein can railways furnish their product in a more economic manner. Before any progress can be made in the application of the principles involved, it is necessary for railway managers to know the actual cost of their commodity.

A thorough study of railway methods discloses the utter absence of standards which will serve as a comparative unit among the various roads, or even on the same road during different periods. In the operation of a railway much dependence is placed on the ratio of operating expenses to the gross earnings as a measure of efficiency in operation. Careful analysis of this standard will disclose it to be useless for the purpose, inasmuch as an increase or decrease in the revenue per ton hauled will alter the ratio, notwithstanding the highest efficiency of management in both instances. In the maintenance of locomotives, the generally accepted standards are cost per locomotive or cost per locomotive mile. Inasmuch as the size of the locomotive, the operating conditions, and the tonnage hauled all affect the maintenance cost, the value of either of the above standards as a basis is changed and all comparison is destroyed. The same objections apply to comparisons of maintenance of both passenger and freight cars.

In measuring locomotive performance considerable stress is often laid on the mileage run between engine failures, but careful investigation shows that there is a great variation as to the definition of an engine failure on different roads, and that the personality of the division master mechanic, trainmaster, and the division superintendent are all important factors in the determining of performance, irrespective of the actual record. It is, evident, therefore, that considerable attention must be directed to the formulating of proper standards for the purpose of measuring the efficiency, not alone of the individual departments, but of the railway as a whole. On one road the low cost of repairs per locomotive mile was given considerable prominence, while no attention was paid in any manner whatever to the cost of fuel, or to the tonnage hauled, which further indicates that standards must be provided on an extensive and comprehensive basis, since all of the various items of expense are finally included in the cost of furnishing transportation.

Proper standards having been determined upon, a suitable system of keeping records should be inaugurated in order that accurate measurements may be made at any and all times with reference to the situation in each individual department. The bookkeeping of the various costs oftentimes destroys any com-

*Manager of the department of effective organization, Suffern & Son, New York City. This contribution was entered in the competition on the application of scientific management to a railway shop, which closed June 15, 1911.

parison that might be made due to the variation in what constitutes a capital or maintenance charge. This is particularly noticable in the cost accounting of shop production, one railway adding 10 per cent. above the actual cost of labor and material to cover surcharge, while another finds it necessary to add as high as 90 per cent. Inasmuch as 10 per cent. will barely take care of the shop buildings, it is very evident that many items which should be legitimately included in the surcharge are not given any consideration. Further, from the rules laid down by the Interstate Commerce Commission for the handling of the accounting features, it is perfectly feasible and proper for any road to add from 40 to 60 per cent. of its shop labor, charged to a general expense account that may be afterwards prorated over other accounts which have not participated whatever in the labor involved in this charge.

The present organization of the general officers on a railway does not conform to the ideal. Fundamentally there are two separate departments in any manufacturing business, divided between those who sell the product and those who spend the money in manufacturing it. In other words, one department gets the business while the other department spends the money. Therefore, an ideal organization would be one where these two departments were entirely separate and with officers at the head of each continuously watching the details in each department. On a railway, for example, the traffic department in reality acquires but a portion of the business. The general manager, general superintendent, or division superintendent spend a great deal of their time looking out for business in their local territories or in pacifying dissatisfied shippers, while their expenses are charged entirely to the operating or manufacturing side. It is safe to say that the average general manager, being on the manufacturing side, knows but little of the details of the manufacturing costs.

As to the method employed in the application of these principles, this must needs vary according to local conditions. One of the fundamental weaknesses on many roads is the failure to accord recognition to the ability of men in the mechanical department. In commercial life men rise regularly from the manufacturing department to the head, but in the railway work the cases where men have risen out of the mechanical department are rare. At the same time instances are numerous where men have left the mechanical department of railways and risen to the highest positions in commercial fields. Such a condition makes the department fundamentally weak, as there is no constant upward current, and stagnation results. The railway organization should be so modified that merit in the mechanical department is recognized, experience given in other departments, and a regular line of promotion established. The mechanical department should be made an active, integral part of the business of conducting transportation.

Second in the mechanical department to weakness of stagnation is the fact that, on a majority of roads, the organization is purely line. The application of knowledge to the business is therefore difficult, as the line is occupied with the routine duties and there is no staff to study the problems and apply knowledge. More than this, as there has been no encouragement to acquire knowledge in special branches, few in the line organization are competent to be recognized as authorities. Every road should have a staff organization, the personnel of which would differ on different roads and under different circumstances. In every case there should be a chief of staff with only staff duties. On the larger roads the staff might contain several members whose only duties would be staff, while on the smaller roads the assistants might have duties on both line and staff. For instance, a man might hold the line position of master mechanic and be the staff authority on machine tools. All problems concerning machine tools should be referred to him, and it would be his duty to keep himself so posted as to be able to solve these problems. The fact that staff positions would demand that a man keep posted on subjects outside of his routine duties would help to keep him out of a rut and would broaden his horizon. This feature alone would be of great value to a road.

The chief of staff should be a man with a wide range of experience, a keen sense of proportions, a good imagination and an analytical mind. He should direct the work of the staff, pass on all reports, make all recommendations, and make personal studies of the organization and general conditions in the shops. He should also act as the intermediary between the mechanical and the other departments and, in this capacity, produce the harmonious working of all for efficiency. One of his first steps in a shop should be to provide for adequate, reliable and summarized records. The immediate knowledge of costs is as important in a railway repair shop as in a manufacturing establishment, and the records should be so arranged as to show the costs of each operation. Later, standards can be established and any departure from the standards, either above or below, should be investigated. Costs which are obtained weeks after an operation is performed are valuable only as history. In many cases the costs can be obtained the day after an operation is performed and in all cases they should be obtained not later than the second day. If the cost keeping is properly done, this will not require an excessive clerical force. It takes just as many clerks to determine costs six weeks after an operation as it does to determine them the next day. It is simply a matter of keeping up with the work. The records should not only display the costs but should also contain full information as to men and operations. By using a duplicate carbon cost ticket these records may all be made at once.

Summarized reports, possibly in graphical form, should be given to the shop superintendent each week. These reports are the pulse of the shop and show the conditions immediately. The superintendent can at once apply remedies to those that are not normal. Another important record which should be kept is that of the materials used. The importance of this record can be illustrated by a concrete example. In one shop the record showed that 16 piston packing rings were being drawn for each engine that passed through the shop, regardless of the condition of the engine or whether the engine was simple or compound. As the compounds called for only eight rings this excessive use of material was investigated and the discovery made that the foreman ordered the extra rings to "allow for breakage." Needless to say the breakage was immediately reduced. The record also showed that certain parts applied to engines at the central repair shop were being removed at other shops and engine houses. Many other irregularities were revealed and stopped.

Just what would constitute the staff in any specific case cannot, of course, be stated in a general article, but in all cases the assistants in a broad sense should cover chemistry, power, tools and machinery and methods. Each should be the recognized authority in his staff position.

The chemist should study the problems of lubricants, materials, fuel and water. He should furnish specifications and arrange for tests that will assure the greatest economy—that is economy in the final analysis when viewed from all standpoints. He should also arrange for an inspection that would prevent departure from the standard specifications. The records should bring to his attention any inefficiencies arising from items under his jurisdiction. For instance, the question of unusually hard castings should at once come to his attention.

The assistant on power should be responsible for all problems of power and light, from the receipt of the fuel to the delivery of the power and light to the machines and men. He should not only provide for the most economical production of power and light, but also for the most efficient distribution. This means efficiency from all standpoints. Fluctuating and intermittent power and light are far from efficient. Neither is power efficient which is consumed by poor bearings and machinery, shafting out of line, bad belts, or leaks in the line. In one large plant the leaks in the air line consumed the entire power of a 100 h. p. compressor. This condition had existed for a long time, but

nothing was done until the power became a specific problem for one man. In the same plant a saving of 30 per cent. was made in the fuel bill by the adoption of coal specifications and a change in the design of the grates. Of course on the last problem two of the staff assistants worked together.

The assistant on tools and machinery should solve the problems of securing and supplying standardized tools and machines. He should provide designs of tools for maximum production and also arrange for a method of handling which will eliminate loss of time to the workmen. Only recently in a large shop which was inspected the machinists were noticed taking their tools to the forge where they were dressed according to their own ideas. New tools were also made to the workmen's designs. It was the old story of everyone's business and no one's special duty. The tools should all be made and ground to standard designs and a machinist should always be able to secure a new tool without leaving his machine or losing time. The providing of adequate grinding facilities is a very important duty, but is usually left to a clerk to simply order an "emery wheel." This member of the staff should be responsible for the condition of all tools and machines and for the design of labor saving devices. The workmen will be of great assistance in this if suggestions are encouraged and the co-operation of the men secured. In commercial enterprises it has been found profitable to pay for useful suggestions. There is every reason to believe that this policy would pay on a railway.

The assistant on methods should handle the problem of securing the greatest efficiency from the workmen. He should provide for the planning, routing and despatching of work and so arrange for doing it by the most efficient methods that the work will be handled the fewest possible number of times, and that it will be so despatched that each piece is ready when needed, and also so that at least one job will always be assigned ahead to each workman. This despatching is exceedingly important as no matter how efficient the workmen may be, or how willing they are to work, there is loss if the work is not kept up to them. There is also a loss if each piece is not ready at the right time. It is not an infrequent occurrence for an engine to stand in the shop while workmen idle around it waiting for some part to be rushed to completion. The assistant on methods should also arrange for the inspection of incoming parts to be repaired, of outgoing parts after repairs, and of finished new parts. It is not at all infrequent for the final decision as to repairs to be made, and of new material to be ordered, to descend to some workman. Engines have been sent to the shop with no instructions except, "Needs general repairs." Careful inspection should be made and no work should be done or material ordered without proper authorization. The inspection should extend to the engines in service in order that repair parts may be prepared before the engine comes to the shop. One case comes to mind where an engine waited nine months for a part, although it was known for a year before the engine came to the shop that the part would be required. This assistant should also supervise the ordering of material from the storehouse and the return of scrap. The handling of scrap is very important, as the neglected scrap pile always eats up money. Economies can be effected not only through the efficient handling of scrap, but also through the prevention of serviceable material getting into the scrap, and by studying the market in order to sell at high prices.

Standard times should be established for each operation, standard methods of doing the work provided, and records kept of the efficiencies. The advisability of offering a monetary incentive for attaining the standards would be determined by local conditions. The standards should be established and the records kept in any case, as much improvement can be made without the bonus. There are incentives which can be applied other than money. In all cases harmonious working must be striven for, the organization must be constructive, and everyone in the shop must be encouraged to think.

SHOP KINKS; FROM AN EASTERN SHOP.

BY AN OLD RAILROADER.

TRUCK FOR MOUNTED WHEELS.

A simple truck or buggy for handling mounted engine truck wheels between the engine house and the machine shop, without using the turn-table and pit tracks with the resulting delays, is shown in Fig. 1. When first built it was fitted with two movable plates *A*, which were used for running the wheels on and off the truck, but these have been removed and wedges are now

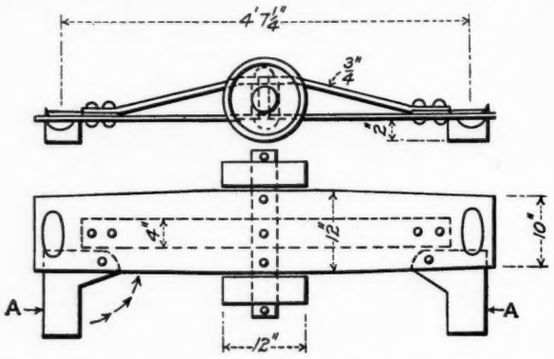


Fig. 1—Truck for Mounted Engine Truck Wheels.

used for placing the wheels on the plate or floor of the truck, which is only 2 in. above the ground. Two 5/8-in hooks are used to catch the spokes of the wheels, and two men can handle a pair of 36-in. wheels easily. The floor of the truck is made of ½-in. boiler plate, with a 4-in. by ¾-in. brace extending over the axle. The floor is dished out at each end to keep the wheels from rolling off the truck.

PISTON HEAD MANDREL.

A mandrel for turning piston heads on a vertical boring mill is shown in Fig. 2. Most railways use a standard taper and standard sizes for the fit of the piston rod in the piston. The mandrel has a lug which fits the center hole of the boring mill table, and two lugs or projections which fit in slots in the table,

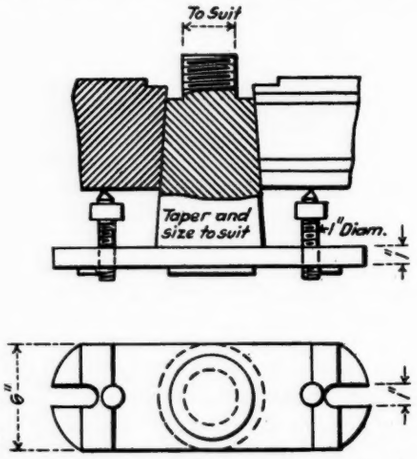


Fig. 2—Mandrel for Machining Piston Heads on a Boring Mill.

thus relieving the strain on the clamping bolts. A nut and a washer on the end of the mandrel draw the head down tight. The two 1-in. set screws are used for removing the head when it is completed. In machining the piston heads, they are first bored and reamed to size for the piston fit and are then placed on the mandrel. The nut and washer are applied and the roughing and finishing tools are placed in the two heads of the boring mill, these two operations being performed at the same time. Standard tools for the packing ring grooves are then placed

in the heads, and after the grooves are finished the nut and washer are removed and one of the boring mill heads is used to recess the piston head for the piston nut, while the other boring head operates a tool for rounding off the corners of the piston head. On a 50-in. boring mill, seven piston heads, 22 in. in diameter and 6 in. thick, were finished complete in 10 hours at a cost of 43 cents each for labor. This is much less than the same work could be performed for on a lathe.

ROD TRUCK.

The truck shown in Fig. 3 is not a circus stake puller, as might be inferred at the first glance, but is used for transporting side and main rods from the engine in the erecting shop or engine house to the machine shop. With it one man can handle a main rod much easier than three men could handle it otherwise. The buggy is run over the rod, or rods, and the handle is raised. A chain is passed around the rod a little back of the

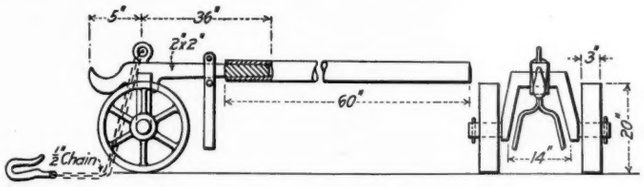


Fig. 3—Truck for Connecting Rods.

center and is hooked up. The handle is then pulled down and the rod is raised from the ground, the lighter end catching in the fork just back of the wheels. I have seen men pick up rods so close to the center that when the handle of the buggy was in a horizontal position, the rod would remain so. It is then an easy matter to push the rod about the shop or engine house.

CROSSHEAD SHOE JIG.

A jig which facilitates the planing of babbitted crosshead shoes is shown in Fig. 4. It is practically one-half of a crosshead, except that it does not contain a hole for the piston rod. The shoes are bolted on, as shown, and a special tool, which finishes the shoe in eight strokes of the planer, is used. The finished crosshead shoe is 6 1/32 in. wide. The tool has a 2¼ in. cutting face and is also made so that the sides will cut. The first two cuts are taken in the center and then one at each side. Then the finishing cuts are taken in the same

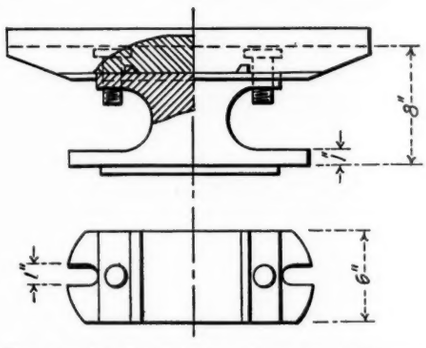


Fig. 4—Jig for Planing Crosshead Shoes.

manner. I have used a tool with the cutting edge the full width of the finished crosshead, but in crowding it would occasionally pull off the babbitt. When the shoe is removed, no scraping or fitting is required. A pair of these shoes may be planed up at the cost of six cents.

AIR PUMP VALVE LIFT GAGES.

Two gages for getting the correct lift of the discharge and receiving valves of 9½-in. air pumps are shown in Figs. 5 and 6. In Fig. 5 the application of one of the gages to the air chamber cap is shown; when the movable piece comes in contact with the projection on the cap the other end of the gage shows the correct distance to the valve when the gage is laid on the cylinder casting into which the cap screws. Fig. 6 shows the valve in position and the gage checking the lift, the other end of it having been properly set. As shown

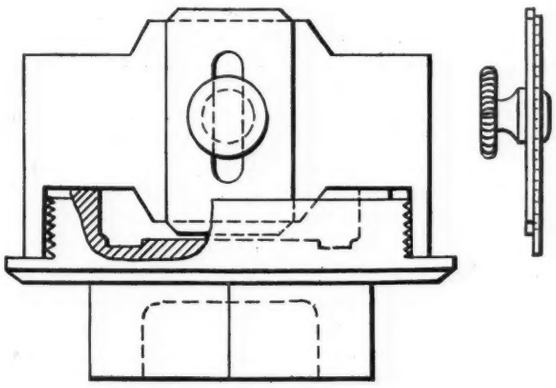


Fig. 5—Gage for Checking the Depth of Air Pump Receiving Valve Cap.

on the sketch, the valve has too much lift. When the sliding scale or piece is set for the cap as shown in Fig. 5, or for the valve as shown in Fig. 6, the reverse end of each gage is correct for the lift of the valve in the first case, or the depth of the receiving valve chamber in the second case. The construction of these two gages is such that the use of the

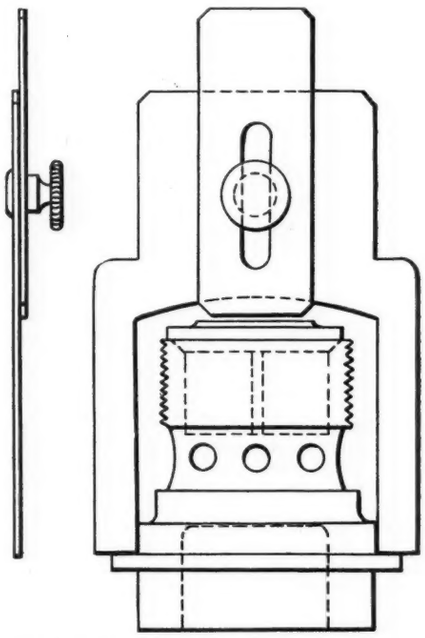


Fig. 6—Gage for Checking Lift of Air Pump Receiving Valve.

depth gage is done away with. As only one scale is used, there is less possibility of error. The center pieces are movable in both gages and may be locked in any position by the knurled nut or thumb screw. The gages are made of 1/16 in. sheet steel, hardened and ground. Gages for 8-in. and 11-in. air pumps may be made in the same way.

In Baden they plan to decorate their waiting rooms with photographs, of a uniform size of 30 in. x 60 in., representing picturesque landscapes, buildings, etc., in the grand duchy. Photographers, professional and amateur, are called upon to submit pictures, bearing in mind that they must be attractive when enlarged to this great size, and prizes are offered for the best ones.

THE MAKING OF GOOD MECHANICS.*

BY D. C. DAVIS.

Apprentice Instructor, Atchison, Topeka & Santa Fe, Newton, Kan.

Any apprenticeship system to be a success must have the approval and support of the highest officials. It should be in charge of a man who has had experience in handling other men, one possessed of the personal magnetism necessary to draw men to him and promote mutual confidence. He should also be a man who is in full sympathy with the work and in position to devote both time and energy to it. The local officials can do much towards building up such a system by their co-operation. The shop foreman of today is not the fatherly, easy-going individual of former days, but a business man to whom the management looks for the shop output. He has his own work to be taken care of and to be done in the least possible time and will not have much time to spend with beginners. If a boy is quick and bright he may pull through by himself with a comparatively small amount of attention, but the slower and more plodding brother will be dropped unless some one takes the time to show him. This is where the shop instructor becomes a necessity. It is his duty to instruct the boys in the correct and most efficient methods. He should have from twenty to twenty-five boys under his care, but not more than this. He should be capable of performing any of the operations called for in the shop. He should be neat in his personal appearance and have good morals, as his influence on the boys under him is great. The success of the apprenticeship system is determined largely by the competency of this man.

When the boy enters the service he should supply himself with the necessary tools to do the work in his department, unless they are furnished by the company. An experienced workman can work with poor tools but it is difficult for beginners to learn to do any kind of work properly with such tools, or no tools at all. Each boy is shown how to do his work right and to properly care for his tools. He is advanced as rapidly as possible after having become proficient in any line of work, the object being to provide as much variety as possible and to keep the boy from apparently standing still, as this leads to discontentment. Boys are treated with respect and are made to feel that they are a part of the shop organization; that the shop in which they work is a good place to stay, and they are encouraged to feel at home there.

The school instructor, who conducts the classroom work, should be educated in the technical branches and also have experience in practical work. What was said as to the shop instructor's habits and morals is just as applicable to the school instructor.

Each boy attends school four hour a week, on company time, and is paid the regular rate while attending school. The classroom should be as light and cheerful as possible. The subjects taught are: Mechanical drawing, sketching, mathematics, the principles of mechanics, and business letter writing. All of this work should pertain directly to the shop work with which the boy is familiar; in other words, should be a supplement to the shop work. For example, a boy is put in the valve gang in the shop. The school instructor knows when the change occurs and the boy is given work on valves in the schoolroom. The principles of the different valve gears are explained to him, and by sketching and supplementary reading matter furnished by the instructor he learns how the changes and adjustments are made and why. The shop men say that this is a help to the boy because he understands the work and takes hold of it better.

When a boy is a little backward on some line of work in the shop it is found that if he is drilled on that particular branch in the school it nearly always brings good results. Therefore the boys are instructed individually in the school, as in the shop, since one boy may require more help than another. It sometimes happens that two boys in the same class are working on the same thing, and, if the instructor sees fit, he may allow them to work together.

In some places the schoolroom is used by the boys as a sort of clubroom, where they hold meetings in the evenings about twice a month. Here they discuss mechanical subjects pertaining to their trade. They are governed by parliamentary rules. In this way they learn to express their thoughts intelligently without becoming frightened at the sound of their own voices.

A careful record is kept of each boy, and at a moment's notice one can tell just what and how well each one is doing, both in the school and in the shop. This outline of the method of teaching and training apprentices may be modified and used to advantage in training other help. Many men in the shop would work harder and take more interest in the work if they felt that there was an interest taken in them. In some places night schools have been established for shop men. The same objection holds here as with boys; a few will stick to it and get the benefit and others feel that they cannot afford it, and cannot spare the necessary time.

*Submitted in the competition on the instruction of workmen and apprentices which closed April 15, 1911.

APPLICATION OF SCIENTIFIC MANAGEMENT TO A RAILWAY SHOP.*

J. S. SHEAFE,

Engineer of Tests, Illinois Central.

The application of a more or less scientific management is being followed up in almost every shop of any size in the country. Increase of judicious economy is increase of efficiency, the latter meaning increase of scientific management. In all fairness to the efficiency engineers it is doubtful just how far their massive scheme of minute detail can be advantageously applied. The application of scientific management, in some cases, has been the introduction of piece work. This is always a good thing if careless work can be overcome, the right count made, and not to be overlooked, if an accurate knowledge can be obtained of the cost the necessary additional force adds to the work, or the finished article.

There is a pressing need in most shops for a more careful check on the time of doing certain classes of work, even if only a close approximation. A cost of labor and material can easily be recorded, for future comparison, and the record can be kept by the foremen and gang foremen. Should a locomotive go into the shop for a general overhauling, and tires be ordered after stripping, there is room for improvement.

An important part of scientific management would be the addition of an engine and boiler inspector. As soon as an engine arrives dead on the shop track, it should be carefully surveyed and material for repairs immediately assembled. A good boiler man should be ready with new side sheets, firebox, or any part of the boiler. Time would be saved, and hence money, and the output would be increased.

This would be facilitated by standards, the best recommendation of the efficiency engineers. If the standardization of shop practices and tools were the only thing accomplished by them, their value would be inestimable. What a great thing it is for an engine house man in a small town to wire in for an engine part and merely name it, telling the engine number! It applies equally as well to car repairs, passenger and freight, but means more work on the part of the drafting force and closer touch on their part with what is going on in the shop.

When a machine is set up for making a certain piece, extra parts should be made and added to the stock, thus saving the expense of again setting up. A maximum output, with the quality of the work not under a high mark, and a minimum of expense, will be scientific management. To attain the maximum output several things must be considered; in the first place, pre-

*Submitted in the competition on the application of scientific management to a railway shop, which closed June 15, 1911.

liminary planning is necessary as to what will be needed, when needed and how it will be obtained. This means proper supervision, or a head who can see the critical moment far in advance and have all preparations made to meet it. Work can be well done just as easily as poorly done, and with far greater satisfaction to the one who does it.

It is almost axiomatic that minimum cost follows maximum output. The man responsible for a shop's success would not have the ability to produce the maximum output unless he were also able to do it, not cheaply, but at a reasonable cost.

Consider a shop where everything is clean and neat, the employees making large wages under piecework and bonus systems. The output is large and everything about the place looks prosperous and good. Every cost can be shown instantly (and correctly?) and anyone will admit it to be a shop to which so-called scientific management has been applied. However, the painting may have been the most carefully done work, and while the rolling stock looks nice it will not stay out in service. In an endeavor to keep down the cost, records and competition in records have a tendency to promote less exact work. The repairing of rolling stock in such manner that it goes out and sticks is really the good old fashioned, hard shelled management that keeps trains on time, makes money for the stockholders and upbuilds the reputations of the operating officials. One may prove that 2 = 4 on paper, or that the returns from a 10 acre fruit farm will exceed the most extravagant wants, but the conditions do not change for all that. It takes just so long to accomplish a certain piece of work. An amount of figuring will perhaps bring out some short cut, or improvement, but if it does, disregarding the usual "personal equation," it merely reveals the inventive genius of the man who accomplishes it.

If we are to have scientific management, let us go for it in a reasonable manner, as some shops have. Their attempts at improvement are not radical, but are successful. The best man is enabled to make the most money, as is right. His work corresponds to his pay check. The standardizing of everything possible is a large factor in the total plan. Free rein to, and proper recognition of, original ideas is lacking in some railway shops, and the "what's the use" idea is very prevalent. In general it may be said that if all loafing is eliminated, the indifferent and careless workman let out, co-operation and harmony built up, scientific management has imperceptibly crept in and will influence everybody and everything constantly and appreciably.

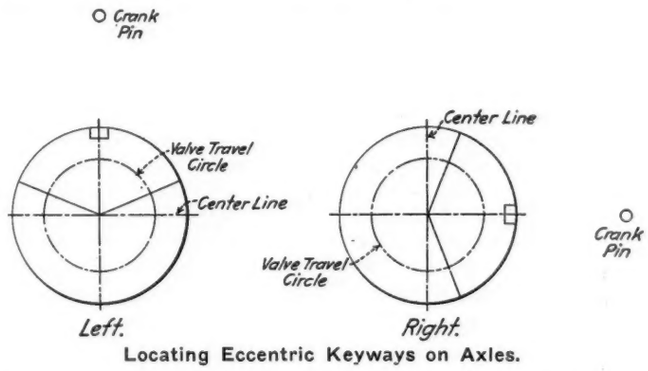
LAYING OFF ECCENTRIC KEYWAYS ON AXLES.

BY JOHN V. LE COMPTE.

Foreman, Baltimore & Ohio, Newark, Ohio.

Laying off axles for eccentric keyways can, if care is exercised, be accomplished with a degree of accuracy that will eliminate the use of offset keys. Many methods have been employed to obtain the exact position of keyways, but if the axle is new no better method can be employed than that of placing the axle on V blocks on a surface plate or on the platen of a planer. The exact center of the axle should first be obtained by means of calipers, the hole for the lathe center being plugged with soft lead. The first line drawn through this exact center, as shown on the accompanying illustration, should be one perpendicular to the bottom of the keyway for the wheel center and axle, provided this keyway is in a line between axle and crank pin centers. The next line, called the center line, is drawn through the center perpendicular to the first line. Next, draw a circle from the exact center with a diameter equal to the valve travel. In determining the valve travel many mistakes have been made by using the throw of the eccentrics. This does not necessarily equal the valve travel, for one arm of the rocker may be longer than the other, thus making the travel different from the throw of the eccentric. From both points where the center line intersects this circle, lay off on the circle, towards the crank pin, a distance equal to the lead plus the lap that is to be given the engine. Through these new points draw lines to the exact center. These lines will locate the middle of the keyways and their bottoms should be made perpendicular to them, the forward motion eccentric to follow the main pin and the back motion to lead.

In cases where mistakes in laying off keyways are made or where they have been worn and new ones are required, the main wheels are changed over, or twisted around, the left wheel on the right side and the right on the left. This, of course,



Locating Eccentric Keyways on Axles.

necessitates new keyways, as the old ones would not be in the correct location. To obtain the new positions of the keyways, draw a circle on a piece of tin the same diameter as the axle and proceed as before, obtaining the location of the keyways on the tin instead of on the axle. To locate the new keyways on the axle itself, draw a line on the inside of the wheel center from the exact center of the crank pin toward the exact center of the axle; where this line meets the axle draw a line along it, parallel to its axis. From this second line locate the keyways, by means of dividers, laying off their center lines as found on the piece of tin.

FLUE SHEET CINDER FORMATION IN LOCOMOTIVES.*

BY ROBERT JOB.

Flue sheet cinder is the technical name for a growth which forms, as the name implies, on the flue sheets of locomotive boilers, gradually covering the ends of the flues, unless laboriously removed by the fireman, and ultimately choking the draught. Under some conditions this formation never occurs, and an engine may run year in and year out without difficulty due to this source, but with certain changes the same locomotive may suddenly find a normal rate of steaming out of the question. The composition of these clinkers varies decidedly, and the following analyses of some taken from engines using different types of fuel, will give a general idea of the range which may be found:

	No. 1 Anthracite Coal. Per Cent.	No. 2 Bituminous Coal. Per Cent.
Silica	52.15	28.54
Alumina	34.51	12.30
Total Iron (figured as Fe_2O_3)	10.29	52.00
Total Sulphur (figured as SO_3)	0.81	4.30
Lime (CaO)	2.68	2.75
Magnesia (MgO)	0.27	0.40
	100.71	100.39

In these analyses the total iron has been figured for convenience to the sesquioxide, although a part existed in the ferrous state. Clinker No. 1 was of a greenish-red color, while the other was of a deep red due to the higher proportion of iron and to its more complete oxidation. It is interesting to note that in most cases relatively little sulphur was present in these clinkers, or "sulphur lumps," as they are often called, and the proportion of alkalies was usually low. The cinders were generally of a characteristic

*Abstract of a paper read before the American Society For Testing Materials at Atlantic City, June 27 to July 1, 1911.

structure and examination under the microscope showed that they were built up of small dark-colored particles which had fused together, resulting in a dense though somewhat porous form. Under service conditions it may be almost impossible to remove these cinders from the flue sheet owing to the more or less plastic state caused by the high temperature of the firebox. When cool they are, however, rather brittle and break with a vitreous fracture.

It was evident that the quality of the coal was of great importance, and a large number of analyses were made of a representative sample of the coal used and of the cinder found on the same run when the formation occurred. On making a comparison, it was found, in general, that the composition of the coal-ash corresponded with that of the cinder, but the percentage of iron in the cinder was always higher than in the ash from which the latter was composed. Moreover, the fact was generally developed that when the proportion of iron in the coal-ash was low, say, below about 1 per cent., or when the color of the ash was white or gray, no formation of cinder, or only a slight one, appeared upon the flue sheets, regardless of the proportion of ash present in the coal. In fact, no formation was observed with coal of this character even when the proportion of ash in the coal averaged over 25 per cent. Under these latter conditions the flues themselves became more or less choked with the light powdery white ash, "sulphur dust," as the deposit is termed, but it did not adhere to the flue sheet and no clinkering occurred. Analysis showed that the percentage of iron in these flue ashes was lower than that originally present in the coal-ash. In other words, the particles containing iron, being heavier, tended to remain behind and not to be drawn into the flues. It also developed that as the percentage of iron in the coal-ash increased, the tendency toward and the extent of the flue sheet cinder formation increased, beginning often when about 2 per cent. of iron was present in the ash. When the ash contained 2.5 per cent. of iron the clinker formation on the flue sheet was more marked, and it generally became excessive when the ash contained 5 per cent. of iron.

Throughout this paper the proportions of iron have been figured, unless otherwise stated, in terms of metallic iron (Fe) for convenience of comparison. In the course of the investigations it was thought that the excess of iron found in the cinder might be derived in some manner from the firebox itself, owing, perhaps, to the action of fumes or of moisture upon the steel, but investigation showed that under the ordinary condition of service, pitting or corrosion of the sheets within the firebox or combustion chamber did not occur, thus proving that the iron in the clinkers was present originally in the coal and was concentrated in the clinker.

From the results of the study, it appeared that the formation of the flue sheet cinders was due principally to the presence of iron in the coal-ash in proportions exceeding about 2½ per cent. Also the actual building up of the cinder was readily understood when we considered that upon shaking the grates, or even by the jolting of the engine, fine particles of ash were loosened and were then easily drawn over to the flues by even a gentle draught. The high temperature of the firebox and combustion chamber brought these fine particles to a partially fused, pasty condition when they contained a fair proportion of iron, and on coming in contact with the flue sheet they adhered to it and were ready to hold the particles next drawn against them, thus gradually building up the clinker.

It was found in service that the clinker grew from the bottom of the flue sheet upward, this being due to the fact that the particles of oxide of iron which were relatively the more fusible, were also of course the heavier and were thus first drawn against and adhered to the lower part of the flue sheet. The cinder accumulated there until the lower flues were partly closed; the draught was then diverted upward and pasty particles of iron were carried higher and higher until the flues were more or less completely closed and combustion was seriously affected

In the course of the investigation it was found that flue sheet cinders may not in some cases be produced even when the proportion of iron in the ash runs relatively high, the difference being due to the proportion of ash in the coal. When less than 10 or 12 per cent. of ash is present with the proportion of iron indicated above, the flue sheet cinders may be expected to form, but if with the same content of iron, the proportion of ash in the coal averages about 15 per cent., or more, the complaint is apt to be that the coal "has no heat," the reason being that so much clinker forms upon the grate that the draught is interfered with and this, in turn, prevents the particles of iron from being drawn and forced against the flue sheet to the same extent that would occur with a better draught. Also, owing to the lower temperature in the firebox under these conditions, the particles are not apt to be in a partly fused condition and they consequently merely collect in the flues but do not adhere to them.

Choking of the draught through the grates is especially liable to occur when the proportion of ash in the coal is very low, say, less than 5 per cent., with a high proportion of iron, as, for instance, 7 per cent., or more, and we know of cases under these conditions in which the clinker upon the grates was so fluid that it "ran like molasses," as the men said, sticking to the grate and effectively cutting off the draught. It has also been noted that flue sheet cinder formation is greater in simple than in compound engines, this being due to the fact that a larger number of ash particles are drawn against the flue sheet under the stronger draught of the simple engine. Also the formation is much more rapid with wet coal than with dry, this condition being readily accounted for by the dissociation of the moisture in contact with the incandescent coals into oxygen and hydrogen gases which, in connection with the draught in the firebox, produce intense heat and fuse into cinder particles, ash which contains a relatively smaller proportion of iron than that which causes clinkering with dry fuel. Owing to this condition flue sheet clinker formation is apt to be more prevalent in the winter months than in the drier season.

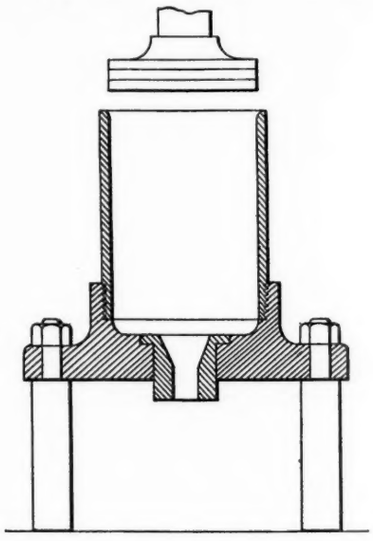
From the general statement which has been made it will be clear that the formation of flue shee cinders is an index of the fusibility of particles of the ash, and it might be thought that whatever would tend to decrease the melting point of the ash likewise might be expected to increase this type of cinder growth. The evidence obtained seems to indicate, however, that this does not necessarily follow, and the decided increase of iron which was found in the flue sheet cinders shows that this element has a large influence in promoting the formation. We have found as a matter of practice that flue sheet cinders can be avoided under ordinary conditions of service, by use of white ash coal, or coal in which the proportion of iron is less than 1.5 per cent., when figured as Fe.

Discussion.—The discussion was a brief experience meeting, in which it developed that, in some cases, the cinder formation had begun at the top of the tube sheet instead of at the bottom, a condition explained on the basis of the draft being greatest through the upper rows of tubes. It was also suggested that the condition of the ends of the tubes might also be a cause of an increase of cinder formation. For example, if the beading were to be burned off so as to leave a rough end projecting into the firebox, these rough places would afford a most efficient means of catching the particles of plastic cinder as they passed. The relationship between tube leakage and cinder formation was also touched upon, with the expressed and uncontradicted opinion that leakage was a cause of cinder formation rather than the reverse. For it had been found that, in some instances, tube leakage had stopped after the flue sheet cinder had formed and been knocked off.

On the 1st of April, 1910, President Dorner, the head of one of the Prussian railway directories, was engaged to take charge and organize the management of the state railway of Chile, some 2,200 miles, and was given leave of absence for that purpose. Apparently Chilian politics have been too much for him, and after a year's stay he returned to Germany.

GREASE PRESS.

A simple grease press in use in the Canadian Pacific roundhouse at Glen Yard, Montreal, is shown in the illustration. It consists of a 6-in. pipe that has been bored out and screwed into



Grease Press.

a cast iron base. This base receives the grease die which is slipped in from above. After the pipe is filled with the grease to be formed, the piston is forced down by air pressure, driving the grease out through the die in the base.

INSTRUCTION OF APPRENTICES AND HANDY MEN.*

BY AN OLD RAILROADER.

The machine shop foreman is the man to whom the greater part of the work in developing mechanics from raw material belongs. On the selection of this raw material and the care it is given depend the quality of workmen that will be sent out three or four years later.

Years ago it was an easy matter to get good, healthy, intelligent boys to learn the mechanical trades because there were less inducements in other walks of life. Today it is a hard matter to get a boy of any intelligence to even make a start to learn a trade, especially those trades in railway shops. Their parents do not care to see them spend four years working for hardly enough to pay their board and clothe them decently, and then face the uncertainty of steady work when the apprenticeship is completed, for even if they could afford to let them learn a trade, as a rule 90 per cent. of the roads do not want the young men when they have completed their apprenticeship. They are furloughed as soon as free to make room for the allotted number of men. Then again the annual reduction in both force and hours has a strong tendency to keep boys who would make good mechanics away and lands them in other pursuits that may not pay as well in wages per hour, but which pay far better on a yearly basis.

Very few parents want to see their boys leave them at a time when they should be getting some returns for the years of care and expense that they have been put to in raising them and giving them a schooling. It is certain that a young man when his trade is learned will want to work at it. This results in having to leave home, for, as stated above, he is not wanted in the shop that has been making money out of his labor for three or four years.

Some years ago this was not the case. A young man that paid attention to his work and showed any marked ability was given every chance to go ahead, his superiors knowing full well that in the years to come he could be depended on and would be able to fill any position. There is no such an opportunity now. Those positions are only open for college graduates or men from technical schools who can take a piece of paper and a lead pencil and show how the work should be done and the savings that can be effected. It is my experience and I believe it is so with all other railway men (I mean mechanics), that not one in fifty of the class of men mentioned can do a good shop job of any description, although they can figure the saving that may be effected on all jobs, even to the way a cotter pin should be applied and opened. Not one in twenty knows enough to figure the cost, if a saving of five minutes is affected in doing a job and a vital part is neglected in the hurry to make the efficiency man's figures good. If a wreck or breakdown occurs on the line, which is often the case, on whom does the blame fall? Not on the efficiency man. Oh, no! He is too valuable; he is saving for the company on paper at the terminal on an average of $10 per day over and above his salary, or percentage, and the company is paying out one hundred times as much due to failures and breakdowns caused by the new hurry-up methods. This is an everyday occurrence and the man that was driven to do the work so that the other's figures were made good is either suspended or discharged for inefficiency, for simply doing as he was told.

Pardon me for getting away from my subject, but I believe it will help to show why so few good and capable boys are learning the mechanical trades at the present time, particularly in railway shops. Another reason is that there are two and sometimes three classes of apprentices in nearly all shops. All three may be working at the same class of work and their wages vary as much as two to one. This is not a good incentive for the low-priced boy. Knowing that he is only getting one-half as much as the other felow, he will lag a little at first and go from bad to worse, resulting in being let out entirely. This practice has a demoralizing effect on all. The only boys that seek such employment are in the majority of cases those who cannot be made to attend school and are placed in some railway shop to keep them out of mischief. Few, if any, of this class ever complete their time.

Apprentices should be handled just as they were when they first entered school. Begin by getting their attention fixed on learning to run a machine by showing and instructing them in the various movements until they get acquainted, letting them ask questions and being always ready to give them an answer. Get their confidence and when this is done the rest is easy. Tell them that you expect them to make mistakes of various kinds, but insist that they must not forget the causes leading up to each one that they do make. By this means they will in a short time begin to make progress and then the work can be given to them.

One thing should be emphasized and that is to do the work well, even if it does take a litte more time at the start. Let speed come afterwards. Regular changes should be made from machine to machine, and at stated times, for those that do good work. This acts as a prod to those that are liable to lag or are slow due to other causes. It is with this last class that the foreman or instructor should spend his time developing their weak points and in cases even helping them along by taking the machine in hand and demonstrating how the work should be done, letting them see that you are interested in having them develop and keep up with the others.

The foreman should see that all the boys study drawing and learn to understand the reading of blue prints or sketches. It must be admitted that in a great many shops there are very few that understand blue prints or their use. This should not be the case.

The writer with hundreds of others had the advantage of learning his trade under a man, the results of whose work

*Entered in the competition on the instruction of workmen and apprentices which closed April 15, 1911.

may be seen today in the men who served time under him and who are now holding positions from foreman up to general manager, superintendent and general superintendent motive power from New York to California. Others are holding important positions in industrial concerns and financial institutions. They were taught to do every job well, even if it took a little longer time, to shirk nothing, and if a mistake was made to go at once and report it, not trying to hide it or shove the responsibility on some one else's shoulders. Those are the methods that were pursued 30 years ago and resulted in good workmen. They ought to be carried out today, instead of trying to make a boy resemble a machine by driving him at a fixed rate, so as to get the maximum output per hour, not taking any account of the quality of the work, just so it is thrown out of the machine and passed up to the other fellow.

Handy men should be handled in much the same manner as apprentices. The writer is, however, not in favor of instructing them, as it has a bad effect on the apprentices, and leaves that many less openings for them. As a rule the handy men only learn to do one class of work, and at no time can they be called mechanics, no matter how proficient they may become on any one machine or job.

SCIENTIFIC SHOP METHODS.

Tracy Lyon, assistant to the first vice-president of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., and formerly general superintendent of the Chicago Great Western, presented a paper on Scientific Industrial Operation, at the Congress of Technology at the fiftieth anniversary of the granting of the charter of the Massachusetts Institute of Technology, from which the following extracts are taken:

There is a new schoolmaster abroad, or perhaps he might better be called a doctor, the "efficiency engineer," who stands ready to apply his medicine in the most scientific, though sometimes impractical manner. There seems to be little doubt, however, but that scientific methods can be applied to advantage to any business, large or small, the only difference being that, in the case of very large industries, many years may be required to accomplish the task without an undue upsetting of conditions. Scientific methods involve a casting aside of precedent and established usage, the determination by systematic observation and analysis of conditions as they are, not as they seem to be, and the application of the information so obtained to individual tasks.

It has been demonstrated that a man can be taught to double or even quadruple his output, with no greater or even less physical exertion, by means of a use of tools and a distribution of effort which he unaided would be incapable of evolving. What the labor cost of an individual operation should be can only be determined by analytical time studies in which personal equation and past performances are disregarded and every move is considered. The simple application of a graphic ammeter to a motor driven machine tool may tell a surprising story of repeated delay and undeveloped capacity. It may be said on behalf of employers that such studies are sometimes discouraged, to say the least, by the workmen themselves.

In order to bring out the best and most intelligent effort on the part of most men it is necessary to establish and recognize a reasonable measure of their efficiency. To develop this efficiency to its highest degree, there must exist methods of compensation which will offer a comparatively large return for increased individual effort; an organization which will effectively plan in advance to bring together at the right time all information, tools and material required, and which will furnish adequate instruction and supervision and a carefully considered arrangement of appliances and machinery which will bring about an economical movement of the work. A very essential function of such an organization is to create a feeling of copartnership between employer and workman and an understanding that the employer is not trying to get the most for the least wage, but is willing to pay liberally for increased output and efficiency.

Many manufacturers do not know what the real and actual cost of their product is, particularly if it is diversified, because of a lack of adequate cost accounting and because the overhead or general charges are not properly distributed, to their own detriment as well as to that of the public. This is not an easy question to solve, but there are scientific methods of accomplishing it. I believe that railways would purchase many articles they now manufacture if they had a truer knowledge of their shop costs—railway shops have no balance sheets to face and do not necessarily go out of business if they are not making money.

On one railway with whose operations I was familiar some years ago, allowances were established for the cost of repairs to equipment per ton mile, or mile run, for the cost of coal used by locomotives per ton mile, for roundhouse expenses per locomotive handled, for terminal expenses per car switched, for freight house expenses per ton of freight handled, as well as many other expenses. These allowances were based upon a more or less scientific study of what the cost should be, and each foreman and station master knew every day whether he was ahead or behind of the game. Such records and comparisons may perhaps be shown most clearly if plotted as curves. In fact I do not believe that the financial and operating details of any large and complex business can be properly appreciated and studied without the use of graphical records. By their means a field can be covered and comparisons made which would be impossible with the use of figures alone.

Scientific methods involve the use of the most expert advice obtainable, as to the selection and handling of material, the choice and maintenance of tools, the processes of manufacture and operation and the elimination of wastes.

Scientific methods would not permit factories to be poorly lighted as many are. It can be demonstrated that the cost of furnishing the very best light obtainable is inconsiderable in comparison with the benefits to be derived in an improvement in the quality of work and increased production. The same thing may be said of the cost of improving sanitary and other conditions which affect the comfort and health of the workman and of maintaining orderliness and cleanliness.

APPLICATION OF ECCENTRICS TO DRIVING AXLES.

BY JOHN V. LE COMPTE,
Foreman, Baltimore & Ohio, Newark, Ohio.

Eccentrics should be applied to the axles sufficiently tight to prevent slipping. This requires that the keys should be of sufficient width and thickness to withstand the forces to which they are subjected. In the case of axles 7½ in., or over, in diameter, the key should not be less than 1¼ in. wide and 1 in. thick, and the set screw should be 1 in. in diameter, cupped at the end and hardened so that it will cut into the axle and help prevent the eccentric from turning. An important feature that is often overlooked is that the eccentric itself should firmly clamp the axle. It may easily be made to do this by placing a piece of paper about .005 in. to .008 in. thick between the halves when they are being bored and turned for the axle fit. This will leave a small space between the halves which, when they are applied, will allow them to firmly grip the axle, as the bolts are tightened. The eccentric bolts must, however, be of good size to allow this feature to be effective.

The eccentric should be applied to the axle before it is placed under the locomotive, as more accurate fits of the keys can be obtained, the nuts and bolts may be drawn tighter, and the mechanic has more room in which to work. In every case where the distance between the driving boxes will allow eccentrics with bosses should be used, and not narrow ones, such as are often used for the back motion eccentrics; this to guard against the many failures caused by eccentrics shifting on the axles.

General News Section.

At Saltburn-by-the-Sea, England, July 1, F. Bordino, an Italian, traveled in an automobile 116.13 miles in one hour.

The American Employees and Investors' Association has established a branch organization with 2,500 members at Houston, Tex.

Announcement has been made by the St. Louis & San Francisco that its new shops at Springfield, Mo., will be operated to full capacity beginning July 1.

Flying from Paris to Sedan, June 26, Lieut. de Malherbe of the French army traversed the distance of 178 miles between these cities in 1 hour, 45 minutes, or at the rate of nearly 102 miles an hour.

In connection with the new educational bureau of the Illinois Central, W. L. Park, vice-president, has issued a circular on "The Value of Courtesy," which will be sent to about 2,000 conductors and agents of the road.

A bill has been passed by the legislature of New York and signed by the governor amending the public service commissions law by more specifically empowering the commission to regulate and fix commutation fares.

The Atchison, Topeka & Santa Fe has been exempted by the state corporation commission of Oklahoma from maintaining separate waiting rooms for colored and white patrons in its stations at Alva and Fargo. Similar exemptions had previously been granted to the road at a number of other points in that state.

The Toledo, St. Louis & Western has been advised by the Indiana railway commission that its roadbed in that state must be improved as to ballast, ties, rails, bridges and culverts if the present high speed traffic is to be continued on it. Frank W. Morse, general manager, has agreed to begin remedying the defects at once.

Rather than make orders in rate cases now pending before them which may conflict with those of the Interstate Commerce Commission, the state commissions of Washington and Oregon have asked for a conference with the interstate commission to discuss the questions involved. The conference will probably be held in September.

Referring to reports regarding increases in the pay of Pullman conductors and porters, an officer of the company says that the wages of all such employees in the service of the Pullman Company throughout the country have been advanced, taking effect June 1 instead of July 1, as reported. The increases are based on a graduated scale depending on the length of time in service.

Steps are being taken by the Union Pacific to expand and improve its hospital system by building in the larger cities new hospitals or buying established institutions, to serve which the best physicians and surgeons will be regularly employed and which will be supplied with the best equipment. Similar improvements are being made in the hospital department of the Illinois Central.

The Pennsylvania Railroad reports that on the lines east of Pittsburgh and Erie during the month of March 67,912 passenger trains were run. The percentage arriving at division terminals on time was 92, which is about 7 per cent. better than in March, 1910, when the number of trains was somewhat less. In April the percentage on time was 91.6, also a considered improvement over April of the preceding year.

Referring to the contracts recently secured by the Wells, Fargo & Company Express to take over the business of the Pacific Express Company on the different Gould lines, William Sproule, president of the Wells, Fargo & Company Express, in a newspaper interview, made an absolute denial of the reported acquisition by his company of the control of the Pacific Express Company.

The Central Railroad of Oregon has been advised by the Oregon railway commission that unless the roadbed, rails and equipment on its line from Junction, Ore., to Union are repaired, the attorney-general of the state will be advised to take the matter in hand and be asked that the road be turned over to a receiver. Officers of the road assured the commissioners that their orders would be complied with.

The following changes in the names of operating divisions of the Illinois Central went into effect July 1:

Old Name.	New Name.
Chicago	Illinois
Peoria	Indiana
Freeport	Wisconsin
Dubuque	Minnesota
Cherokee-Omaha	Iowa
Louisville	Kentucky

J. W. Walker, an engineman of the Southern Pacific, in Arizona, who has completed 25 years of service without ever having to go "on the carpet" or ever having an accident of enough consequence to require a formal report, has been advised that the company will pay expenses of a vacation trip for him and his family to any place that he may designate; and, according to the *Tucson Times,* he is going to Boston.

The merger of the four Chicago elevated railways became effective on July 1, the total deposits of stock in New York and Chicago up to June 28 having been 91 per cent. of the full amount. The stockholders of the elevated roads have until July 10 to indicate whether they will deposit under the "all-cash" or under the "cash-and-securities" plan, and the bankers have from July 10 to July 20 to make payments for the deposited stock.

With a view of reducing the smoke nuisance and educating employees in the economic value of proper firing of their engines, the Northern Pacific has arranged for J. T. Conley, a graduate of the University of Minnesota and a practical engineer of the road, to instruct engineers and firemen in the scientific firing of locomotives and to demonstrate how it should be done, the lectures being given in a special instruction train which will stop for a number of days at each of the important points along the road.

H. M. Atwood, in a Wright bi-plane, last week flew from Boston to New York, making the journey in two stages. On Friday he traversed the distance from Boston to New London in 2 hours, 10 minutes, and on Saturday from New London to New York in about 2 hours, 24 minutes, carrying as a passenger his machinist. The distance from Boston to New London by railway is 108 miles, but the aviator went by way of Middleboro and Newport and is said to have traversed a distance of 135 miles. From New London to New York the distance is about 124 miles.

The International & Great Northern has been advised that no valuation of its property in that state will be authorized by the Texas railway commission as a basis for the issuance of securities until all of its unsecured claims have been paid, this being the outcome of a visit to the commission of attorneys representing something like $3,000,000 in personal injury judgments against the road, to whom Chairman Mayfield read that part of the charter to be filed by the company which provides that it must pay its unsecured claims. T. J. Freeman, receiver of the road, has promised that the claims shall be paid as soon as possible.

As result of a conference in Norfolk, Va., between Norfolk & Western Railway officials and nine different branches of organized labor over the entire system of that road, it was agreed after the various organizations affected shall have voted upon it, that there shall be an increase of three cents per hour in wages as soon as the average monthly receipts of the Norfolk & Western shall equal the average receipts of the road for the last six months of the year 1910. This means the agreement will become effective when the average monthly receipts of the Norfolk & Western reach $3,082,000. There is a hope that this may be reached by August 1, but nothing definite may occur until October 1.

A westbound passenger train of the Pennsylvania Railroad was stopped by robbers five miles east of Erie, Pa., on the night of June 30 and shots were fired at the engineman and at passengers who got off the cars; but the express messenger and mail clerks opened fire on the robbers and, being soon joined

by some passengers, managed to drive them away before any of them had got aboard the cars. It is thought probable that the robbers, of whom there were a half dozen, were from an Italian colony living near the place of the hold-up. The train was stopped by a pile of ties fastened across the rails, but was not derailed.

The branch of the American Railway Employees and Investors' Association at Houston, Tex., has elected the following officers: President, G. W. Windsor; vice-president, J. D. Freeman; secretary and treasurer, C. J. McDonald; representative to state board, J. E. Anderson. Two representatives of each of the following roads have been appointed members of the executive committee: Houston & Texas Central, the Galveston, Harrisburg & San Antonio; the St. Louis & San Francisco, the Trinity & Brazos Valley, and the Houston Belt & Terminal; and it is expected that representatives of the Missouri, Kansas & Texas and the International & Great Northern will be appointed to it at the next meeting.

The Illinois Central has decided to offer first, second, third and fourth prizes, ranging from $50 to $15 to be awarded at the annual state fair at Springfield, Ill., for the best exhibits each of grains, forage plants, vegetables and fruits, to be brought to Springfield and displayed by farm boys from the 60 counties of Illinois through which the road operates. The boys must be under 21 years of age, are to be selected in each case through the co-operation of the county superintendent of schools; and their transportation to and from Springfield as well as their sleeping quarters and meals while at the fair, will be furnished by the road. First, second, third and fourth prizes, ranging from $200 to $60 will also be given for the best display, taking the exhibits as a whole.

The Electrical Engineering Department of the Massachusetts Institute of Technology reports that its courses of graduate study have been very successful during the past year. Prof. Jackson's lectures on organization and administration of public service companies have been attended by a class of twelve graduate students. Prof. Pender's and Prof. Wickenden's lectures have been likewise successful. The graduates in the electric engineering course were more numerous this year than ever before. This department of the institute has received a grant of $3,000 from the Edison Electric Illuminating Company to be used in investigating the relative operating reliability and the cost, of electric trucks, gasolene trucks and horse trucking, with a view to seeing what is the relative economy of the different methods in Boston.

Cost of Signal Wiring.

The cost of wires and wooden trunking for the power line, described in the *Railway Age Gazette* of June 30, page 1693, in connection with new signaling at Washington, D. C., was four hundred and thirty-five dollars per thousand feet. The error of the proofreader, in printing a lower figure ($35), must have been due to the unconscious influence of his feeling that no such large sum ought to be spent on such an inconspicuous feature of a railway! Cost figures are not very common in such articles and his unfamiliarity with them is not surprising.

New York City Subways.

The New York State Public Service Commission, First district, this week awarded five contracts aggregating $16,139,427 for the construction of five sections of a subway under Lexington avenue, Manhattan, from Twenty-sixth street northward to 103rd street—something less than four miles of line.

This action of the Public Service Commission must be concurred in by the Board of Estimate, of the city, but it is understood that this concurrence is assured. The offer made by the authorities to the Interborough Rapid Transit Company two weeks since, for the construction and operation of certain subways, was not accepted, while the offer made to the Brooklyn Rapid Transit Company was accepted. Later the B. R. T. signified its willingness to undertake the contracts which had been rejected by the Interborough. At the present writing it appears likely that the B. R. T. will be awarded contracts for all of the lines which the city desires to have built; and if this is done the result will be competing subway lines the whole length of Manhattan, as well as in sections of Brooklyn and the Bronx.

Of the five sections above mentioned, four are let to the Bradley Contracting Company and one to Charles H. Peckworth.

Mails by Freight.

The plans of the post office department which contemplate sending second class mail in some cases by freight trains and which were to have been put into effect on the first of July have been subjected to further consideration and the new scheme will not be tried before September 1. What the post office department expects to do is to get the benefit of a lower cost of transportation on monthly and semi-monthly periodicals which are shipped in large quantities; and the routes over which it is intended to make the experiment are those from Buffalo and Pittsburg to Cincinnati, Chicago, St. Louis, Kansas City, Omaha and St. Paul. Thus, a magazine going from New York to Denver would go in a mail train to Buffalo or Pittsburg and thence in a freight to Omaha or Kansas City, and the rest of the way by mail train. It is expected to arrange with publishers to mail their magazines for these long journeys a little time in advance so that subscribers will receive their magazines at as early a date as under the ordinary plan.

International Railroad Master Blacksmiths' Association.

The annual convention of the International Railroad Master Blacksmiths' Association will be held at the Boody House, Toledo, O., August 15.17. Among the papers to be read will be one on Tools and Formers, by G. M. Stewart; Drop Forging, by Hugh Timmons; Flue Welding, by C. A. Sesnenbach; Frogs and Crossings, by T. F. Keane; High Speed Steel, by M. F. Gorey; Locomotive Frame Making and Repairs, by Geo. W. Foley; The Oxy-Acetylene Process for Welding and Cutting of Metals, by Geo. Hutton; Case Hardening, by W. F. Stanton; Spring Making and Repairs by J. Engels; and Piece Work and Other Methods of Having Work Done, by T. M. Ross. Reports will be received from the various committees and new officers will be elected. The secretary, A. L. Woodworth, may be addressed at Lima, Ohio.

Western Railway Club.

At the annual meeting of the Western Railway Club, held at the Auditorium Hotel, Chicago, June 27, the following officers were elected for the ensuing year: President, C. B. Young, Chicago, Burlington & Quincy; first vice-president, T. H. Goodnow, Lake Shore & Michigan Southern; second vice-president, H. La Rue, Chicago, Rock Island & Pacific.

American Railway Tool Foremen's Association.

The next convention of the American Railway Tool Foremen's Association will be held at the Wellington Hotel, Chicago, July 11-13. O. T. Harroun, Bloomington, Ill., is secretary.

Traveling Engineers' Association.

The annual convention of the Traveling Engineers' Association will be held at the New Hotel Sherman, Chicago, August 29-September 1. W. O. Thompson (N. Y. C. & H. R.), East Buffalo, N. Y., is secretary.

MEETINGS AND CONVENTIONS.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting.

Air Brake Association.—F. M. Nellis, 53 State St., Boston, Mass.

American Association of Demurrage Officers.—A. G. Thomason, Scranton, Pa.

American Association of General Passenger and Ticket Agents.—C. M. Burt, Boston, Mass.; next meeting, St. Paul, Minn., Sept. 19, 1911.

American Association of Freight Agents.—R. O. Wells, East St. Louis, Ill.

American Association of Railroad Superintendents.—O. G. Fetter, Carew building, Cincinnati, Ohio; 3d Friday of March and September.

American Electric Railway Association.—H. C. Donecker, 29 W. 39th St., New York; October 9-13, Atlantic City, N. J.

American Railway Association.—W. F. Allen, 75 Church St., New York; November 15, Chicago.

American Railway Bridge and Building Association.—C. A. Lichty, C. & N. W., Chicago; Oct. 17-19, 1911, St. Louis, Mo.

American Railway Engineering Association.—E. H. Fritch, Monadnock Block, Chicago; annual convention, March 19-21, 1912, Chicago.

AMERICAN RAILWAY INDUSTRIAL ASSOCIATION.—G. L. Stewart, St. L. S. W. Ry., St. Louis, Mo.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—J. W. Taylor, Old Colony building, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—O. T. Harroun, Bloomington, Ill.; annual convention, July 11-13, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—C. W. Hunt, 220 W. 57th St., New York; 1st and 3d Wed., except June and August, New York.

AMERICAN SOCIETY OF ENGINEERING CONTRACTORS.—D. J. Haner, 13 Park Row, New York; 3d Tuesday of each month, New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. 39th St., New York.

ASSOCIATION OF AMERICAN RAILWAY ACCOUNTING OFFICERS.—C. G. Phillips, 143 Dearborn St., Chicago.

ASSOCIATION OF RAILWAY CLAIM AGENTS.—J. R. McSherry, C. & E. I., Chicago; annual convention, May 22, 1912, Los Angeles, Cal.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Jos. A. Andreucetti, C. & N. W. Ry., Chicago.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—P. W. Drew, 135 Adams St., Chicago.

ASSOCIATION OF TRANSPORTATION AND CAR ACCOUNTING OFFICERS.—G. P. Conard, 75 Church St., New York; December 12-13, Louisville, Ky.

CANADIAN RAILWAY CLUB.—James Powell, Grand Trunk Ry., Montreal, Que.; 1st Tuesday in month, except June, July and August, Montreal.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—Clement H. McLead, 413 Dorchester St., Montreal, Que.; Thursdays, Montreal.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North 50th Court, Chicago; 2d Monday in month, Chicago.

CENTRAL RAILWAY CLUB.—H. D. Vought, 95 Liberty St., New York; 2d Thurs. in Jan. and 2d Fri. in March, May, Sept., Nov., Buffalo, N. Y.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.—D. F. Jurgensen, 116 Winter St., St. Paul, Minn.; 2d Monday, except June, July and Aug., St. Paul.

ENGINEERS' SOCIETY OF PENNSYLVANIA.—E. R. Dasher, Box 704, Harrisburg, Pa.; 1st Monday after 2d Saturday, Harrisburg, Pa.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.—E. K. Hiles, 803 Fulton building, Pittsburgh; 1st and 3d Tuesday, Pittsburgh, Pa.

FREIGHT CLAIM ASSOCIATION.—Warren P. Taylor, Richmond, Va.; annual, Buffalo, N. Y.

GENERAL SUPERINTENDENTS' ASSOCIATION OF CHICAGO.—E. S. Koller, 226 W. Adams St., Chicago; Wed. preceding 3d Thurs., Chicago.

INTERNATIONAL RAILWAY CONGRESS.—Executive Committee, rue de Louvain, 11 Brussels; 1915, Berlin.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—D. B. Sebastian, La Salle St. Station, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—L. H. Bryan, D. & I. R. Ry., Two Harbors, Minn.; July 25-27, Chicago.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio; annual, Aug. 15, Toledo, Ohio.

IOWA RAILWAY CLUB.—W. B. Harrison, Union Station, Des Moines, Ia.; 2d Friday in month, except July and August, Des Moines.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Old Colony building, Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION, OF UNITED STATES AND CANADA.—A. P. Dane, B. & M., Reading, Mass.; Sept. 12-15, 1911, Atlantic City, N. J.

NEW ENGLAND RAILROAD CLUB.—G. H. Frazier, 10 Oliver St., Boston, Mass.; 2d Tuesday in month, except June, July, Aug. and Sept., Boston.

NEW YORK RAILROAD CLUB.—H. D. Vought, 95 Liberty St., New York; 3d Friday in month, except June, July and August, New York.

NORTHERN RAILWAY CLUB.—C. L. Kennedy, C., M. & St. P., Duluth, Minn.; 4th Saturday, Duluth.

OMAHA RAILWAY CLUB.—H. H. Maulick, Barker Block, Omaha, Neb.; second Wednesday.

RAILROAD CLUB OF KANSAS CITY.—C. Manlove, 1008 Walnut St., Kansas City, Mo.; 3d Friday in month, Kansas City.

RAILWAY CLUB OF PITTSBURGH.—C. W. Alleman, P. & L. E., Pittsburgh, Pa.; 4th Friday in month, except June, July and August, Pittsburgh.

RAILWAY SIGNAL ASSOCIATION.—C. C. Rosenberg, Bethlehem, Pa.; June 13, New York; annual, Oct. 10, Colorado Springs, Colo.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

RICHMOND RAILROAD CLUB.—F. O. Robinson, Richmond, Va.; 2d Monday, except June, July and August.

ROADMASTERS' AND MAINTENANCE OF WAY ASSOCIATION.—Walter E. Emery, P. & P. U. Ry., Peoria, Ill.; September 12-15, St. Louis, Mo.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo.; 2d Friday in month, except June, July and Aug., St. Louis.

SOCIETY OF RAILWAY FINANCIAL OFFICERS.—C. Nyquist, La Salle St. Station, Chicago; Sept. 12-14, St. Paul, Minn.

SOUTHERN ASSOCIATION OF CAR SERVICE OFFICERS.—E. W. Sandwich, A. & W. P. Ry., Montgomery, Ala.

SOUTHERN & SOUTHWESTERN RAILWAY CLUB.—A. J. Merrill, Grant bldg., Atlanta, Ga.; 3d Thurs., Jan., March, May, July, Sept., Nov., Atlanta.

TOLEDO TRANSPORTATION CLUB.—J. G. Macomber, Woolson Spice Co., Toledo, Ohio; 1st Saturday, Toledo.

TRAFFIC CLUB OF CHICAGO.—Guy S. McCabe, La Salle Hotel, Chicago; meetings monthly, Chicago.

TRAFFIC CLUB OF NEW YORK.—C. A. Swope, 290 Broadway, New York; last Tuesday in month, except June, July and August, New York.

TRAFFIC CLUB OF PITTSBURGH.—T. J. Walters, Oliver building, Pittsburgh, Pa.; meetings monthly, Pittsburgh.

TRAIN DESPATCHERS' ASSOCIATION OF AMERICA.—J. F. Mackie, 7042 Stewart Ave., Chicago; annual, June 18, 1912, Louisville, Ky.

TRANSPORTATION CLUB OF BUFFALO.—J. M. Sells, Buffalo; first Saturday after first Wednesday.

TRANSPORTATION CLUB OF DETROIT.—W. R. Hurley, L. S. & M. S., Detroit, Mich.; meetings monthly.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y.; annual, August 29-September 1, Chicago.

WESTERN CANADA RAILWAY CLUB.—W. H. Rosevear, P. O. Box 1707, Winnipeg, Man.; 2d Monday, except June, July and August, Winnipeg.

WESTERN RAILWAY CLUB.—J. W. Taylor, Old Colony building, Chicago; 3d Tuesday of each month, except June, July and August.

WESTERN SOCIETY OF ENGINEERS.—J. H. Warder, 1735 Monadnock Block, Chicago; 1st Wednesday in month except July and August, Chicago.

WOOD PRESERVERS' ASSOCIATION.—F. J. Angier, First National Bank bldg., Chicago.

Traffic News.

"Interstate Commerce Bureau" is the name of a concern that has been started at Portland (Ore.), and has been incorporated with a capital of $50,000, to audit freight rates, adjust overcharges and carry on a general shipping business for shippers.

To exploit the Rainier National Park, in the state of Washington, the Chicago, Milwaukee & Puget Sound has inaugurated (June 24) a new train service to this point from Seattle; two trains daily each way between Seattle and Ashford, from which point passengers are taken to Rainier in automobiles.

Contrary to reports, the Gould lines will not abolish the joint traffic office they have maintained at Chicago. It is officially announced that the office will be continued as at present, in charge of E. B. Boyd, with title of assistant to the vice-president. The Texas & Pacific is the only road that has withdrawn from the joint arrangement.

The Cumberland Gap Dispatch, a fast freight line operating over the Norfolk & Western, announces that it has arranged for through cars to be run daily from Norfolk, Va., to Pueblo, Denver, and Salt Lake, over the Missouri Pacific. Heretofore this line has sent its Colorado freight over the Union Pacific. The Cumberland Gap Dispatch takes its freight from New York and other Atlantic ports by the Old Dominion steamships.

Effective July 8, the Harriman Lines have announced reductions on all standard grades of lumber of 75 cents a ton on through shipments from Seattle, Wash., and Tacoma, and of 60 cents from Gray's Harbor, to points on the Southern Pacific in California, Nevada, Utah, Arizona and New Mexico. Rates to points south of Roseburg, Ore., will, on the same day, be reduced to the basis in effect prior to May 22, 1910.

John H. Gates, who was appointed special master in chancery by the United States court to take testimony in the passenger rate cases in South Dakota, has made a report, saying in substance that while a 2½-cent rate might be upheld as constitutional by the higher courts, a straight 2-cent passenger rate in South Dakota would be out of the question. He takes issue with the recent decision of Judge Sanborn in the Minnesota rate cases, where the value and common expense were assigned on a gross earnings basis, and made his findings in the South Dakota cases on the direct expense basis.

Condition of the Cotton Crop.

The crop reporting board of the department of agriculture estimates that the condition of the cotton crop on June 25 was 88.2 per cent. of a normal, as compared with 87.8 on May 25, 1911, 80.7 on June 25, 1910, 74.6 on June 25, 1909, and 80.0 the average of the past ten years on June 25.

Comparisons of conditions, by states, follow:

States.	June 25, 1911.	May 25, 1911.	June 25, 1910.	June 25, 1909.	June 25, Ten-yr. Av.
Virginia	98	93	81	76	82
North Carolina	89	83	72	75	80
South Carolina	84	80	75	77	80
Georgia	94	92	78	79	**80**
Florida	96	95	82	88	85
Alabama	93	91	81	64	79
Mississippi	87	86	81	61	**79**
Louisiana	89	91	77	62	78
Texas	85	88	84	79	80
Arkansas	89	87	77	76	81
Tennessee	87	83	82	80	84
Missouri	90	86	80	83	84
Oklahoma	87	87	88	84	81
California	100	95	95	..	..
United States	88.2	87.8	80.7	74.6	80.0

For the purpose of comparison, the condition of the cotton crop in the United States monthly for the past ten years is given below:

Years.	May 25.	June 25.	July 25.	Aug. 25.	Sept. 25.
1910	82.0	80.7	75.5	72.1	65.9
1909	81.1	74.6	71.9	63.7	58.5
1908	79.7	81.2	83.0	76.1	69.7
1907	70.5	72.0	75.0	72.7	67.7
1906	84.6	83.3	82.9	77.3	71.6
1905	77.2	77.0	74.9	72.1	71.2
1904	83.0	88.0	91.6	84.1	75.8
1903	74.1	77.1	79.7	81.2	65.1
1902	95.1	84.7	81.9	64.0	58.3
1901	81.5	81.1	77.2	71.4	61.4
Average, 1901-1910	80.9	80.0	79.4	73.5	66.5

Car Surpluses and Shortages.

Arthur Hale, chairman of the committee on relations between railways of the American Railway Association, in presenting statistical bulletin No. 97A, giving a summary of car shortages and surpluses by groups from February 16, 1910, to June 21, 1911, says:

"The total surplus reported for this date is 165,934, a decrease of 3,072 cars since our last bulletin. Box and coal car surplus shows very little change, there being an increase of 557 cars in the former and a decrease of 577 cars in the latter. There was a decrease of 1,009 in the flat car surplus, principally in groups 3 (Central) and 10 (Pacific), and a decrease of 2,043 cars in the miscellaneous surplus. The decrease in the latter item is made up chiefly of coke cars in groups 2 (Eastern), and stock cars in group 8 (Middle Western). There are decreases in the box car surplus in group 4 (Middle Atlantic) which group also reports some shortage of this class, and in group 9 (Southwestern), where there has been some movement of winter wheat. The shortages in the Canadian group, noted in our last bulletin have increased, and with the increased shortage reported in group 4, bring the total shortage up to 2,764, of which 1,667 are box cars."

The accompanying table gives the surpluses and shortages by groups for the last period covered by the report and the chart shows total bi-weekly surpluses and shortages.

INTERSTATE COMMERCE COMMISSION.

The Interstate Commerce Commission on June 27 authorized the Carolina, Clinchfield & Ohio to carry Virginia coal to southeastern points at rates in some cases lower for the longer than for the shorter distance.

The commission announced last week its intention to begin an extensive inquiry into the business of all the principal express companies, throughout the country. This action is taken by the commission on its own motion, but complaints of excessive charges or unsatisfactory service have been received from numerous cities at various times during the past year. Immediately after this announcement came another saying that all of the principal express companies, except the Long Island, had filed tariffs, to go into effect August 1, showing reduced rates in important features of the tariffs, especially those for shipments over the lines of two or more companies, where the weight is less than 100 pounds.

Complaint Dismissed.

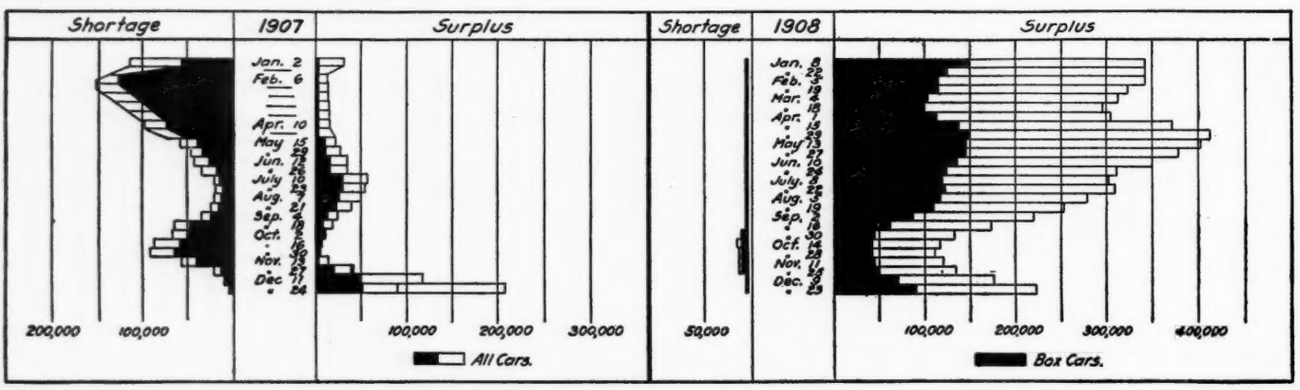
Racine-Sattley Co. v. Chicago, Milwaukee & St. Paul et al. Opinion by Commissioner Prouty.

Reparation formerly awarded having been made, no opinion is expressed on the reasonableness of the rate. (21 I. C. C., 164.)

CAR SURPLUSES AND SHORTAGES.

Date.	No. of roads.	Surpluses Box.	Flat.	Coal, gondola and hopper.	Other kinds.	Total.	Shortages Box.	Flat.	Coal, gondola and hopper.	Other kinds.	Total.
Group *1.—June 21, 1911	8	374	424	894	308	2,000	0	33	25	34	92
" 2.— " 21, 1911	22	2,548	116	17,524	6,493	26,681	10	22	29	5	66
" 3.— " 21, 1911	26	10,549	942	37,370	4,194	53,055	0	0	0	0	0
" 4.— " 21, 1911	10	1,252	184	4,372	819	6,627	331	192	0	0	523
" 5.— " 21, 1911	19	4.960	417	3,093	1,999	10,468	18	20	0	0	38
" 6.— " 21, 1911	25	11,821	958	3,650	5,516	21,945	30	20	0	4	54
" 7.— " 21, 1911	4	1,630	46	469	631	2,776	0	0	0	0	0
" 8.— " 21, 1911	17	7,786	143	2,628	3,201	13,758	0	0	0	0	0
" 9.— " 21, 1911	11	1,350	549	474	862	3,235	55	1	0	0	56
" 10.— " 21, 1911	21	9,088	1,908	2,392	9,023	22,411	0	0	0	0	0
" 11.— " 21, 1911	6	1,850	96	20	1,012	2,978	1,223	212	0	500	1,935
Total	169	53,208	5,783	72,885	34,058	165,934	1,667	500	54	543	2,764

*Group 1 is composed of New England lines; Group 2—New York, New Jersey, Delaware, Maryland, and Eastern Pennsylvania lines; Group 3—Ohio, Indiana, Michigan and Western Pennsylvania lines; Group 4—West Virginia, Virginia, North and South Carolina lines; Group 5—Kentucky, Tennessee, Mississippi, Alabama, Georgia, and Florida lines; Group 6—Iowa, Illinois, Wisconsin, Minnesota and the Dakotas lines; Group 7—Montana, Wyoming and Nebraska lines; Group 8—Kansas, Colorado, Missouri, Arkansas and Oklahoma lines; Group 9—Texas, Louisiana and New Mexico lines; Group 10—Oregon, Idaho, California and Arizona lines; Group 11—Canadian lines.



Car Surpluses and Shortages in 1907 to 1911, Inclusive.

Rates on Liquor Found Unreasonable.

In re suspension of advance rates by express companies for liquor. Opinion by Commissioner McCord.

The use of arbitrary weights on the basis of charges for liquor by express companies is found unreasonable. (21 I. C. C., 199.)

Rates on Rice to North Carolina Ports.

In re suspension of advances in rates on rice and rice products. Opinion by Commissioner Prouty.

The only question involved here was that of the relation between the rates from Orange, Tex., Beaumont and Houston to north Atlantic ports. The proposed advances made the rates on rice five cents per hundred pounds higher from Beaumont and Orange than from Houston. The commission finds that the rates on rice and rice products should be the same from Orange and Beaumont by rail and ocean to north Atlantic ports, and that these rates in carloads should not exceed corresponding rates from Houston by more than three cents per hundred pounds. The present L.C.L. rate from Houston to New York is 28 cents, five cents more than the carload rates. The proposed L.C.L. rate from Beaumont and Orange is 41 cents, a spread of 13 cents. The commission holds that the difference between the carload and L.C.L. rate from Beaumont and Orange ought not to exceed 10 cents. (21 I. C. C., 124.)

Discriminations in Storage Regulations.

Swift & Co. v. Baltimore & Ohio et al. Opinion by the commission:

The tariffs of the Baltimore & Ohio provided that the import rate should not apply unless traffic was stored in bonded warehouses or delivered to the carrier at the ship side. The tariff further stated that storage would be accorded by the Baltimore & Ohio in its bonded warehouses provided room is available. The tariff provision was unjustly discriminatory, in that it provided that storage would be given when available. (21 I. C. C., 241.)

Demurrage Refunded.

Wheeler-Holden Co. v. Louisville & Nashville. Opinion by the commission:

Rate charged for the transportation of crossties in carloads from Yaden, Ky., to Cincinnati, Ohio, found to have been unreasonable. Reparation awarded. As the rate demanded was collected without tariff authority, demurrage charges accruing during determination of dispute as to rate, ordered to be refunded. (21 I. C. C., 237.)

Commission Refuses to Limit a Producer's Market.

Alabama Coal Operators Association v. Southern Railway et al. Opinion by Commissioner Meyer:

Shipments of coal to points in Georgia, South Carolina, and Florida, Birmingham, Ala., takes differentials, under Coal Creek, Tenn., varying from 15 to 70 cents per ton. The Birmingham coal operators seek to have these differentials increased. Under the conditions found here rate construction on a per-ton-per-mile basis would give to distance an exaggerated influence, resulting in relatively prohibitive rates beyond certain distances and the elimination of competition. The realms of commercial activity of a producing point can not be limited to a definite radius and all other producers excluded therefrom. Nor can differentials be computed at a fixed rate per mile. The present adjustment is not shown to be either unreasonable or unjustly discriminatory. (21 I. C. C., 230.)

Increased Coal Rate Not Proved to be Reasonable.

Victor Manufacturing Co. et al. v. Southern Railway et al. Opinion by Commissioner Meyer:

The commissioner finds that a rate of $1.95 per ton for the transportation of coal from Coal Creek, Tenn., to Spartanburg, S. C., found to be unreasonable and rate of $1.85 prescribed. Carriers left to work out proper readjustment of rates and differentials, and no order made fixing a differential to apply to the Virginia fields over Coal Creek. (21 I. C. C., 222.)

Rates on Locomotives.

In re the investigation and suspension of advance in rates by carriers for the transportation of locomotives and tenders named in a schedule filed with the Interstate Commerce Commission. Opinion by Commissioner Meyer:

Original order in this case modified to provide that for the transportation of locomotives, and locomotives and tenders, live or dead on their own wheels, charges will be on basis of a minimum total haul of 75 miles.

Important Reduction in Anthracite Coal Rate.

Henry E. Meeker and Caroline H. Meeker, co-partners, trading as Meeker & Co., v. Lehigh Valley:

Complainants buy, ship and sell anthracite coal, using the lines of the Lehigh Valley. They are not mine operators, but merely dealers in the New York market. The Lehigh Valley Railroad Company controls the Lehigh Valley Coal Company, which in turn owns large tracts of coal land. The Lehigh Valley Coal Company makes contracts with the independent operators known as percentage contracts. The Lehigh Valley Coal Company agrees to pay the independent operators a fluctuating price for their coal at the mines to be arrived at on the basis of certain percentages at tidewater. Under the contract which was in effect during 1900 the Lehigh Valley Coal Company agreed to pay coal operators 60 per cent. of the tidewater price on the highest grade of anthracite coal. Although the Lehigh Valley Railroad Company was not nominally a party to any of the percentage contracts entered into by the Lehigh Valley Coal Company, yet it made a practice of settling for the freight charges on coal purchased and shipped by the Lehigh Valley Coal Company for the differences between the amounts paid to the coal operators and the average market prices at tidewater. It will be seen, therefore, that the freight rates of the Railroad company were directly dependent on the contracts with the Coal company. In August, 1901, a new 65 per cent. contract was entered into and the Lehigh Valley Railroad Company made a systematic effort to pay back to all shippers, including the Lehigh Valley Coal Company, such amounts as had been paid during the period November 1, 1900, to August 1, 1901, in excess of the tariff rates [the 60 cent rate]. Meeker & Company refused this settlement, insisting on a settlement on the basis of the newly adopted 65 per cent. contract. The complainants contend that the payment of increased retroactive prices to the coal producers by the Lehigh Valley Coal Company was in fact a payment by the Lehigh Valley Railroad and therefore a readjustment of its freight charges on the basis of 65 per cent. contract on such coal as was shipped by the Lehigh Valley Coal Company from November 1, 1900, to August 1, 1901.

In view of the admissions on the supplemental hearing, the conclusion seems inevitable that the financial condition of the Coal company was not such as to have enabled it to pay $231,090 to the coal operators out of its own treasury, and that not only this amount, but much larger sums were advanced by the Railroad company to the Coal company to help it carry on its business. The $231,090 paid by the Coal company to coal operators was in fact made from funds advanced as cash by the Railroad company. Reparation is awarded.

Complainants insisted that the average rate per ton mile on coal ought not to exceed the average rate per ton per mile on all freight, and ask for reparation on the assumption that the higher ton-mile rate on coal is proof of the unreasonableness of the rates in question. Attempts are made to get a valuation of the property.

Complainants' contention that the rates to Perth Amboy are unreasonable is based in part upon the testimony of certain persons who were formerly officers of the Delaware, Susquehanna & Schuylkill Railroad and of Coxe Brothers & Company. For many years prior to 1905, Coxe Brothers & Company were engaged in mining and shipping anthracite coal from their extensive properties in the Lehigh region. They owned and operated the Delaware, Susquehanna & Schuylkill, a road about 28 miles in length, which reached their different collieries and connected with the Lehigh Valley Railroad at a place called Lumberyard or Stockton Junction.

L. C. Smith, former manager of the Delaware, Susquehanna & Schuylkill Railroad, testified that about 1900, he, as manager of the Delaware, Susquehanna & Schuylkill Railroad, made up

REVENUES AND EXPENSES OF RAILWAYS.

MONTH OF MAY, 1911.

*Name of road.	Mileage operated at end of period.	Operating revenues			Operating expenses						Net operating revenue (or deficit).	Outside operations, net.	Taxes.	Operating income (or loss).	Increase (or dec.) comp. with last year.
					Maintenance										
		Freight.	Passenger.	Total, inc. misc.	Way and structures.	Of equipment.	Traffic.	Transportation.	General.	Total.					
Atchison, Topeka & Santa Fe	7,550	$5.035,982	$1,824,995	$7,375,317	$1,110,349	$1,263,626	$157,785	$2,146,693	$190,517	$4,868,970	$2,506,347	.....	$263,055	$2,243,292	—$45,959
Atlantic Coast Line	4,498	1,793,198	595,022	2,588,313	317,406	343,499	42,405	942,031	71,796	1,717,137	871,176	.....	115,000	756,176	89,949
Boston & Maine	2,243	2,340,787	1,254,667	3,879,814	708,161	533,678	36,916	1,621,673	85,162	2,985,590	894,224	$17,179	147,235	764,168	—123,495
Chesapeake & Ohio	1,953	1,904,563	425,730	2,458,376	332,003	477,446	48,900	713,739	66,996	1,639,084	819,292	3,593	93,250	729,635	—70,345
Chesapeake & Ohio of Indiana	285	93,469	17,053	117,130	13,413	28,958	4,493	70,380	4,270	121,514	—4,384	—11	3,790	—8,185	—
Chicago & Alton	1,025[1]	743,021	321,540	1,170,111	110,272	151,589	51,644	411,199	34,585	759,289	410,822	—2,727	37,000	371,095	168,132
Chicago & North Western	7,744[2]	3,929,829	1,469,419	5,955,839	994,650	744,013	94,607	2,407,280	134,254	4,374,804	1,581,035	—14,348	245,000	1,321,687	29,288
Chicago, Burlington & Quincy	9,075[3]	4,621,770	1,686,133	6,956,602	1,461,524	1,225,187	126,603	2,170,713	193,983	5,178,010	1,778,592	—13,165	249,854	1,515,573	483,865
Chicago Great Western	1,495	758,098	217,723	1,055,215	178,675	140,094	44,436	417,093	35,482	815,780	239,435	85	33,940	205,580	43,837
Chicago, Rock Island & Pacific	7,548[4]	3,116,168	1,505,725	4,953,035	816,744	812,124	158,693	2,022,936	138,984	3,949,481	1,003,554	—5,182	206,569	791,803	309,892
Chicago, St. Paul, Minneapolis & Omaha	1,744	786,940	319,613	1,185,300	201,254	150,934	22,405	452,707	41,742	869,042	316,258	—184	65,301	250,773	—17,846
Cleveland, Cincinnati, Chic. & St. Louis.	1,979	1,625,785	602,525	2,444,884	308,727	423,639	69,129	1,014,488	55,722	1,871,705	573,179	—4,958	80,000	488,221	217,982
Delaware & Hudson Co., R. R. Dept.	819[5]	1,550,124	209,947	1,821,045	149,159	284,016	21,768	588,192	48,112	1,091,247	729,798	—349	44,000	685,449	14,735
Delaware, Lackawanna & Western	930	2,247,380	650,963	3,110,663	471,684	474,997	61,632	886,799	60,553	1,955,676	1,154,988	58,951	138,028	1,075,911	—124,501
Erie	1,994[6]	3,086,440	739,220	4,148,627	379,851	664,424	94,953	1,314,849	77,385	2,531,462	1,617,165	—3,088	120,631	1,493,446	250,626
Great Northern	7,346[7]	3,578,068	1,093,655	5,037,181	1,341,769	636,136	82,357	1,411,229	152,733	3,624,224	1,412,957	21,841	398,353	1,036,445	—428,116
Illinois Central	4,574[8]	3,414,532	1,005,807	5,025,569	703,875	1,082,025	107,744	1,853,351	121,844	3,868,839	1,156,730	—7,002	241,522	908,206	225,136
Lake Shore & Michigan Southern	1,663	2,588,771	828,755	3,911,375	718,172	630,163	93,848	1,281,525	73,890	2,797,598	1,113,777	—6,968	135,000	971,809	66,404
Lehigh Valley	1,432	3,014,176	386,707	3,519,574	376,604	488,828	94,660	1,005,013	62,070	2,027,175	1,492,399	—32,844	101,300	1,358,255	211,659
Louisville & Nashville	4,601	3,060,505	937,211	4,272,016	851,509	786,520	91,000	1,453,208	91,552	3,273,789	998,227	11,831	175,000	835,058	—162,681
Michigan Central	1,805[9]	1,572,458	554,675	2,337,916	265,142	337,801	56,951	987,627	49,991	1,697,512	640,404	—3,027	110,000	527,376	—5,617
Minneapolis, St. Paul & S. S. Marie	3,764[10]	1,238,546	387,224	1,745,616	228,809	274,063	53,663	644,794	42,917	1,244,246	501,369	4,233	113,149	392,453	—240,476
New York Central & Hudson River	3,591	5,188,735	2,499,979	8,365,227	1,020,958	1,377,760	202,200	2,991,666	234,873	5,827,457	2,537,770	26,004	418,444	2,145,330	334,309
New York, New Haven & Hartford	2,040	2,479,365	2,246,341	5,179,668	717,453	668,404	23,897	2,024,673	168,029	3,602,456	1,577,212	109,591	274,000	1,411,803	—196,750
Norfolk & Western	1,990[11]	2,527,855	325,084	2,951,246	408,341	534,043	46,809	859,181	59,847	1,908,221	1,043,025	—1,106	115,000	926,919	—77,770
Northern Pacific	6,029[12]	3,456,553	1,289,850	5,091,858	672,887	618,289	103,985	1,701,392	76,896	3,173,449	1,918,409	14,879	254,592	1,678,696	—68,831
Oregon Short Line	1,646[13]	962,700	396,666	1,450,597	264,972	135,230	25,733	352,348	37,446	815,729	634,868	—1,659	58,666	574,543	—318,340
Oregon-Washington R. R. & Nav. Co.	1,740	867,044	422,202	1,371,158	181,791	113,474	46,046	496,076	40,905	878,292	492,866	—3,896	54,579	434,391	—
Pennsylvania *R. R.* Co.	3,977[14]	9,686,177	2,700,101	13,240,682	1,552,964	2,738,705	171,822	4,702,159	350,122	9,515,772	3,724,910	—99,269	531,228	3,094,413	—205,584
Pennsylvania *Co.*	1,416	3,090,075	662,742	4,120,104	438,317	713,860	73,626	1,358,479	90,243	2,674,525	1,445,579	—1,130	182,631	1,261,818	—243,476
Pere Marquette	2,334	873,883	297,861	1,281,126	187,894	227,153	35,005	589,314	35,648	1,075,014	206,112	—10,639	47,245	148,228	—167,188
Philadelphia, Baltimore & Washington	713	853,281	631,258	1,655,820	220,392	258,147	25,025	685,777	32,926	1,232,267	423,553	.....	47,396	376,157	—25,023
Pittsburgh & Lake Erie	215[15]	1,077,721	121,337	1,235,077	157,306	147,898	15,074	295,730	23,545	639,553	595,524	—218	30,000	565,307	—247,935
Pittsburgh, Cincinnati, Chic. & St. Louis	1,467	2,121,225	629,829	3,106,195	418,136	511,915	67,237	1,059,345	73,789	2,130,422	975,773	—724	133,467	841,582	214,390
Southern	7,038	3,128,152	1,292,132	4,823,517	606,080	722,899	126,948	1,742,444	150,102	3,348,473	1,475,044	—26,107	183,253	1,265,684	—10,231
Texas & Pacific	1,885	698,453	327,254	1,095,336	162,003	255,493	22,690	516,108	41,046	997,340	97,996	—949	47,580	49,467	—66,758
ELEVEN MONTHS OF FISCAL YEAR, 1911.															
Atchison, Topeka & Santa Fe	7,550	$54,501,336	$20,807,903	$82,172,761	$11,729,567	$13,052,008	$1,642,840	$24,023,272	$1,769,397	$52,217,084	$29,955,677	.....	$2,722,840	$27,232,837	$2,230,174
Atlantic Coast Line	4,498	20,031,116	7,155,718	29,290,325	3,656,303	4,219,496	494,028	9,634,111	765,304	18,769,242	10,521,083	.....	1,109,000	9,412,083	—8,239
Boston & Maine	2,243	23,688,356	14,180,894	40,952,054	5,386,982	5,636,507	452,643	19,239,797	1,004,863	31,720,792	9,231,262	$66,921	1,942,669	7,355,514	—2,223,214
Chesapeake & Ohio	1,953	22,423,356	4,816,480	28,474,987	3,324,434	5,418,227	498,459	8,485,847	671,629	18,398,596	10,076,391	—5,916	917,123	9,143,352	—1,512,292
Chesapeake & Ohio of Indiana	285	1,102,003	239,203	1,413,875	329,302	320,709	62,006	782,168	55,117	1,549,302	—135,427	69	41,690	177,048	—
Chicago & Alton	1,025[1]	8,400,503	3,905,956	13,305,495	1,622,334	2,074,576	455,871	4,991,176	379,210	9,523,167	3,782,328	—21,977	399,600	3,360,751	—495,442
Chicago & North Western	7,744[2]	44,934,351	17,389,861	68,516,340	8,972,936	8,569,647	1,140,517	28,515,655	1,503,379	48,702,134	19,814,206	—44,007	2,872,000	16,898,199	—195,866
Chicago, Burlington & Quincy	9,075[3]	53,583,280	20,677,599	81,284,819	11,043,208	13,312,406	1,452,430	26,385,321	2,067,198	54,260,563	27,024,356	—104,690	2,744,237	24,175,329	3,570,932
Chicago Great Western	1,495	8,118,101	2,588,641	11,580,704	1,357,207	1,712,520	509,699	4,685,255	385,836	8,650,517	2,930,187	1,934	366,636	2,565,485	—
Chicago, Rock Island & Pacific	7,548[4]	37,888,163	17,743,385	59,203,935	8,546,996	8,372,615	1,735,880	23,083,188	1,524,598	43,263,277	15,940,658	102,199	2,394,348	13,444,111	1,492,306
Chicago, St. Paul, Minneapolis & Omaha	1,744	9,802,184	4,102,363	14,874,404	1,660,870	1,728,671	259,150	5,706,085	343,412	9,698,188	5,176,216	—13,936	665,621	4,496,659	306,032
Cleveland, Cincinnati, Chic. & St. Louis	1,979	18,450,771	7,230,104	28,218,331	3,600,532	4,881,503	911,715	12,016,117	638,172	22,048,039	6,170,292	—78,868	893,548	5,197,876	—1,542,436
Delaware & Hudson Co., R. R. Dept.	819[5]	15,943,820	2,679,374	19,205,433	1,461,349	2,755,383	243,164	6,713,492	463,895	11,637,283	7,568,150	—1,352	499,572	7,067,226	—345,002
Delaware, Lackawanna & Western	930	23,736,868	6,934,250	32,737,062	3,571,482	4,858,124	664,120	9,880,414	659,989	19,634,129	13,102,933	259,797	1,497,164	11,865,566	—2,336,343
Erie	1,994[6]	32,814,241	8,266,415	44,335,168	4,756,611	7,452,123	1,063,312	14,763,301	900,601	28,935,948	15,399,220	—206,081	1,292,727	13,900,412	525,614
Great Northern	7,346[7]	39,500,633	12,128,727	55,696,866	8,539,831	7,143,032	909,886	16,603,584	1,103,930	34,300,263	21,396,603	170,014	3,030,954	18,535,663	—1,891,254
Illinois Central	4,574[8]	37,556,830	11,889,368	56,194,128	6,895,605	11,371,543	1,217,509	19,659,830	1,229,241	40,373,728	15,820,400	—48,763	2,451,516	13,320,121	2,169,816
Lake Shore & Michigan Southern	1,663	28,977,288	10,252,000	44,500,158	7,207,605	6,992,401	1,097,638	15,854,653	872,217	32,024,514	12,475,644	—61,499	1,585,182	10,828,963	—3,638,466
Lehigh Valley	1,432	28,725,125	4,111,739	33,999,731	3,335,295	5,586,731	909,572	10,943,014	708,917	21,483,529	12,516,202	—298,530	1,066,900	11,150,772	—749,531
Louisville & Nashville	4,601	36,161,517	10,698,242	49,879,243	8,335,067	8,737,421	1,036,345	16,195,425	999,537	35,303,795	14,575,448	36,405	1,626,800	12,985,053	—2,415,133
Michigan Central	1,805[9]	17,759,257	6,814,675	27,372,040	3,800,564	4,022,978	825,292	11,580,023	546,009	20,774,866	6,597,174	—41,043	1,245,020	5,311,111	—2,131,315
Minneapolis, St. Paul & S. S. Marie	3,764[10]	14,010,238	4,485,989	19,811,216	2,119,100	2,887,672	488,895	7,507,783	456,829	13,460,279	6,350,937	91,433	1,121,755	5,320,615	—3,024,551
New York Central & Hudson River	3,591	53,940,309	28,161,961	91,992,645	12,461,972	15,926,841	2,209,131	35,254,324	2,452,896	68,305,164	23,687,481	99,469	4,377,578	19,409,372	—1,768,553
New York, New Haven & Hartford	2,040	27,546,312	23,977,623	56,580,574	6,294,521	6,676,176	310,917	22,474,663	1,689,345	37,445,622	19,134,952	1,262,814	3,309,000	17,088,766	—602,723
Norfolk & Western	1,990[11]	27,676,878	3,825,000	32,661,912	3,861,811	6,073,828	536,949	9,811,402	665,289	20,949,279	11,712,633	—8,957	1,205,000	10,498,676	—1,460,362
Northern Pacific	6,029[12]	40,074,471	15,829,924	59,852,579	7,148,154	7,320,499	1,013,234	19,989,751	933,962	36,405,600	23,446,979	422,691	2,958,721	20,910,949	—2,013,420
Oregon Short Line	1,646[13]	12,636,591	4,451,983	18,264,175	2,421,896	1,933,690	303,336	4,507,955	463,923	9,630,800	8,633,375	—18,907	744,143	7,870,325	—1,850,830
Oregon-Washington R. R. & Nav. Co.	1,740	4,223,987	1,917,343	6,558,849	824,165	646,581	230,169	2,573,008	225,871	4,499,794	2,059,055	—40,186	349,979	1,668,890	—
Pennsylvania *R. R.* Co.	3,977[14]	104,541,804	30,302,413	144,312,118	17,903,275	27,079,337	2,042,723	53,249,037	3,725,581	103,999,953	40,312,165	—1,192,246	5,162,215	33,957,705	—6,612,082
Pennsylvania *Co.*	1,416	35,065,390	7,603,610	46,613,607	5,433,576	8,085,471	857,713	16,686,172	936,341	31,999,273	14,614,334	—60,733	2,065,633	12,487,968	—2,525,615
Pere Marquette	2,334	9,881,500	3,604,093	14,644,094	1,931,628	2,331,924	424,774	6,722,876	384,066	11,795,268	2,848,826	—66,892	617,447	2,164,487	—1,655,101
Philadelphia, Baltimore & Washington	713	8,716,443	6,979,194	17,440,119	2,557,420	2,771,107	313,559	7,384,072	401,572	13,427,730	4,012,389	.....	530,420	3,481,969	—116,576
Pittsburgh & Lake Erie	215[15]	12,511,063	1,443,162	14,383,923	1,733,153	1,458,129	164,424	3,485,470	263,105	7,104,281	7,279,642	—4,091	306,576	6,968,975	—1,846,037
Pittsburgh, Cincinnati, Chic. & St. Louis	1,467	24,426,909	7,425,121	35,824,313	4,349,842	6,555,352	793,119	13,475,969	731,604	25,905,886	9,918,427	—9,643	1,499,756	8,409,028	—1,519,714
Southern	7,038	36,701,616	14,737,554	55,729,530	6,885,378	8,823,207	1,414,908	19,016,234	1,632,903	37,772,630	17,956,900	—26,047	2,008,029	15,922,824	470,635
Texas & Pacific	1,885	9,998,433	3,785,565	14,805,772	1,794,866	2,858,076	235,347	6,164,152	412,249	11,464,690	3,341,082	—3,883	551,001	2,786,198	—458,043

Mileage operated on May 31, 1910—[1] 998 miles; [2] 7,638 miles; [3] 9.040 miles; [4] 7,393 miles; [5] 843 miles; [6] 1,961 miles; [7] 7,129 miles; [8] 4,550 miles; [9] 1,746 miles; [10] 3,533 miles; [11] 1,951 miles; [12] 5,849 miles; [13] 1,509 miles; [14] 3,947 miles; [15] 191 miles. — Indicates Deficits, Losses and Decreases.

a statement of cost to move one train of coal from Drifton, a mine of Coxe Brothers & Company, to Perth Amboy, including trackage to the Lehigh Valley Railroad Company, the shipping charges of that company at Perth Amboy, and the return of empty cars, which statement is filed as complainants' Exhibit No. 1.

The total cost per ton shown by this exhibit is 76.54 cents.

J. Brinton White, vice-president and treasurer of Coxe Brothers & Company, who owned the entire stock of the Delaware, Susquehanna & Schuylkill, made frequent calculations as to the cost per ton of the movement of coal from the mines on the Delaware, Susquehanna & Schuylkill to Perth Amboy, and continued these calculations until he "got down to a figure which he knew to be correct." The figure which Mr. White arrived at was 76 cent per ton; but as this 76 cents included the trackage charge of the Lehigh Valley Railroad and the shipping charges at Perth Amboy, he was of opinion that the profit of the Lehigh Valley should have been deducted from the 76 cents, if the profit could have been ascertained.

Defendant has endeavored to show the actual cost of transporting coal from the Wyoming district to the barges at Perth Amboy. Three civil engineers, William J. Wilgus, J. F. Stevens and John F. Wallace, were engaged by defendant to investigate the transportaion of coal from the anthracite region to tidewater for the purpose of ascertaining the cost thereof. They were assisted in their investigation by officers and employees of the road and by engineers in Mr. Wilgus' office. Mr. Wilgus prepared an estimate of the cost of carrying coal based upon theories and formulæ which were approved by the other engineers. His estimate is set forth in a voluminous exhibit known as "Defendant's Exhibit F-3." The exhibit contains all the details from which the final estimate of cost is deducted. The recapitulation of Exhibit F-3 is as follows:

Cost of transporting anthracite coal on the Lehigh Valley Railroad from the Wyoming district to Perth Amboy.

Items.	Perth Amboy terminal.	Main line, Perth Amboy to Coxton.	Wyoming collection district.	Total.
Operating expenses, including taxes.	$0.1189	$0.6915	$0.0866	$0.8970
Interest:				
Roadbed, tracks and structures...	.0700	.1470	.0412	.2582
Equipment	.0096	.0437	.0283	.0816
General facilities	.0012	.0045	.0010	.0067
	.0808	.1952	.0705	.3465
Depreciation:				
Roadbed, tracks, and structures...	.0071	.0034	.0009	.0114
Equipment	.0080	.0646	.0176	.0902
General facilities	.0004	.0015	.0003	.0022
	.0155	.0695	.0188	.1038
Total	.2152	.9562	.....	1,3473
Additions and betterments.....	.....	.....	.....	.0400
Risks and deficits	.....	.....	.....	.1070
Grand total	.....	.....	.....	1,4943

There are many circumstances, however, connected with the preparation of this exhibit, which seriously impair its value as evidence on the question of cost.

Mr. Wilgus testified that the figures which he used in preparing said exhibit as to the value of the roadbed, track, and structures and value of equipment were based on an examination of the road and an examination of the equipment, and that he had attempted to estimate the cost of reproduction. This work he states was done by himself and assistants in his employ. The assistant in his employ, who undertook to make an examination of the road with a view to determining the cost of reproduction, was T. A. Lang, and Mr. Wilgus testified that his calculations are absolutely dependent upon the information furnished by him by Lang.

The story of Mr. Lang's investigation as to cost of reproduction, as told by Lang himself, was as follows:

He left Perth Amboy at 1:20 p. m. on a passenger train for Easton, arriving there about 3:20 or 3:30 p. m. In going to Easton he stood on the rear platform of the train. After arriving at Easton, he did nothing more that day, as it was Sunday. The following morning at 9 a. m., he left Easton on a pony engine, which had a coach on top of the boiler. On this engine he traveled at the rate of 15 or 20 miles an hour, stopping at various points. About 5:30 p. m., of the same day, he arrived at Wilkesbarre, and stayed there all night, all the next day, and the next night. While there, he made computations in the railway company's office. On the following day, he left Wilkesbarre at 8:30 a. m. on a passenger train, and arrived at Easton about 11 or 12 o'clock. He remained in Easton until that forenoon, and then took a train for New York. While at Easton, he devoted a "few minutes" to an examination of the Delaware bridge and the Easton steel viaduct. Based upon this examination, he furnished Mr. Wilgus the data which he required as to estimated cost of reproduction of the Lehigh Valley Railroad.

Mr. Stevens testified in substance that he believed it possible for a competent engineer to get a correct approximate idea of the value of a railway by riding over it, and that he has done considerable work in estimating values by traveling over railways. He stated that he was not prepared to dispute Mr. Wilgus' figures, and that he would not guarantee them; and "that it would be worse than foolish for him to say that he had time to undertake to make a mile-by-mile estimate of the cost of reproducing the Lehigh Valley Railroad." The most that he had to say concerning Mr. Wilgus' estimate was that it was "probably conservative."

Mr. Wallace frankly admitted that his testimony given in corroboration of Mr. Wilgus' figures was a matter of purely personal judgment, based on his experience and observation. He testified that men in his line of business were continually drawing comparisons and making "estimated judgments," and that sometimes they were correct and sometimes wrong. He further stated that it was his custom to value railway property very much as a farmer would value a horse.

The estimate of cost made by Mr. Wilgus is based on the fundamental assumption that the cost of carrying coal is equal to the average cost of carrying all traffic. If this proposition be sound, it follows that by far the greater part of tariffs covering the transportation of coal are improperly constructed, for the rates upon coal are generally much below the average rates.

Moreover, it will be noted that the estimate of cost shows that the average cost of carrying anthracite coal from the Wyoming region to Perth Amboy is $1.49. An exhibit filed by the Lehigh Valley shows that its average receipts per gross ton of anthracite coal to Perth Amboy for the 10 years ending June 30, 1908, were $1.46. It would therefore follow that all anthracite coal which has been hauled by the Lehigh Valley to tidewater has been carried at a loss of about 3 cents per ton. But it is shown by reports on file with the commission that the operations of the Lehigh Valley Railroad for a number of years past have been exceedingly profitable, and as anthracite coal has constituted almost half of its tonnage, it is fair to assume that it has made a profit upon the handling of that commodity.

It requires no extended argument to sustain the proposition that the maintenance of an unreasonably high rate operates to the advantage of the Lehigh Valley Railroad Company as a dealer in coal. The record shows that the only line of demarcation between the Lehigh Valley Railroad Company and the Lehigh Valley Coal Company is one of bookkeeping. Assuming for purposes of illustration that the cost of mining anthracite coal is $2 per ton and the cost of carrying it to tidewater is $1 per ton, it follows that the cost of coal at tidewater would be $3 per ton; and if the published rate were $1 the independent operator and the railroad coal company would be on a fair competitive basis so far as the cost of mining and transportation are concerned. But as between the railway company and its coal company it matters not whether the profit comes from mining or transporting the coal. So, therefore, if, instead of the $1 rate above mentioned, the railway company were to establish a rate of $1.50 per ton, the railway and its coal company would still sell coal at tidewater for $3 per ton, standing a deficit of 50 cents per ton in the mining price and taking an equal profit in the transportation price. But the independent operator cannot recoup himself in this manner, and the best price that he could make at tidewater would necessarily be the mining price of $2, plus the carrying charge of $1.50, or $3.50; and he would enter the market at a disadvantage of 50 cents per ton as compared with the railway and its coal company. It is obvious that such an advantage would enable the railway company and its *alter ego*, the coal company, to monopolize the field of production and the selling market. Whatever the means employed, it is a fact that the railway coal company has monopolized the coal field served by it. In 1901, 47 per cent. of the defendant's coal tonnage to Perth Amboy was controlled by it and 53 per cent. by independ-

ent operators; while in 1908 the defendant controlled 95 per cent. of the anthracite tonnage over the defendant's line to Perth Amboy and the independent operators 5 per cent. During the same period complainant's shipments to Perth Amboy decreased from 147,811 tons for 1901 to 40,562 tons for 1908.

Coming now to the question of the reasonableness of the rates, counsel for defendants asserts that the rates on coal must be sufficient to produce four results, viz: (1) An income sufficient to make up for past deficiencies in current return on investment. (2) A reasonable current annual return upon the investment in the railway and transportation adjuncts. (3) An amount sufficient to provide reasonably for keeping the property up to constantly modern standards—i. e., such improvements as are necessary for public convenience and safety and to enable the railway to get business in competition with other roads. (4) An amount sufficient to provide for a return of the principal of the investment, when and as this principal becomes reduced and extinguished by the exhaustion of coal freight.

Under the first proposition defendant argues that the present rates should be sufficiently high to enable it now to earn the amount by which it has fallen short of paying a 6 per cent. annual dividend in the past, or at least as far back as 1894. It shows that a dividend rate of 6 per cent. applied to its common stock of $40,441,100 for the period from November 30, 1894, to June 30, 1908, would amount to $35,091,276; that during this period the dividends paid amounted to $7,260,264; and argues that upon a 6-per-cent. basis the common stock shareholders suffered a deficiency in dividends during this 14½-year period of $27,831,112. In the Wilgus estimate above mentioned 10 cents per ton is added to the assumed cost of carrying coal to Perth Amboy for the purpose of "making good the deficit of over $20,000,000 in dividends" for past years.

After careful study of defendant's exhibits relating to tonnage and cost of movement, as well as a painstaking analysis of defendant's voluminous exhibits respecting its past and present financial condition, we are of opinion and so find that defendant's rates for transportation of coal from the Wyoming region to Perth Amboy of $1.55 per gross ton on prepared sizes, $1.40 on pea coal, and $1.20 on buckwheat coal are unreasonable so far as they exceed $1.40 on prepared sizes, $1.30 on pea coal, and $1.15 on buckwheat. If the relative tonnage of the several sizes continues as it has in the past, the rates herein found to be reasonable would result in an average reduction in defendant's revenue per gross ton for hauling coal to Perth Amboy of about 11 cents below the figure of $1.46 for the 10 years from 1898 to 1908. As applied to 1908, the last year for which anthracite tonnage to Perth Amboy is shown in the record, the proposed rates would have resulted in reducing its operating revenue by about $247,000 and apparently 95 per cent. of this amount would accrue to the benefit of the railway coal company. By reference to the table above set forth it is at once apparent that such a reduction will have no serious effect on defendant's revenues and will afford ample allowance for interest charges, operation, dividends, and all proper reserve funds.

We are further of opinion that reparation should be awarded upon basis of the rates herein found to be reasonable upon all shipments of coal by complainants from the Wyoming region to Perth Amboy since August 1, 1901. The amount of reparation which should be awarded under our finding in this case cannot be ascertained from the exhibits now on file, and such further proceeding will be had as may be necessary to determine the amount of money due to complainants. (21 I. C. C., 129.)

Reparation Awarded, Notwithstanding Unclean Hands.

A. D. Radinsky v. Oregon Short Line et al. Opinion by the commission:

The complainant is in the junk business and asks reparation for an unreasonable rate charged for a carload of junk shipped from Hanna, Wyo., to Salt Lake City, Utah. The complainant in person gave to the agent of the Union Pacific one bill of lading covering four or five cars of scrap iron and one car of scrap iron, old rope and rubber hose. The total shipment was billed as scrap iron, which took a rate of $4 a ton. When the shipment arrived at its destination, the railway company's inspector discovered that one car contained 16,000 lbs. of old manila rope, a small quantity of rubber hose and the remainder of scrap iron. A rate of $9.60 per ton, that being the rate on a carload of junk, of which the shipment in truth consisted, was then charged. Complainant's testimony as to his preliminary inquiries of the agent relative to the rate on the junk, and his careful verification of these quotations on the very day of shipment, indicate that he was aware that one of the shipments, the one which is the subject of this controversy, would probably take the junk rate. Complainant's action in this matter, in view of his affirmative knowledge of the lower rating usually applicable on shipments of scrap iron distinguished as such from junk, and his positive statement that he was quoted a $5 rate on the shipment from Hanna, leave on the commission an unfavorable impression of his conduct in this instance, and while the commission expresses no opinion in the matter, the fact remains that had the shipment escaped inspection at destination, it probably would have been delivered to complainant as scrap iron under the $4 per ton rate, in which case it is unlikely that this proceeding would have been brought to challenge the reasonableness of the junk rate. This feature of the case will form the basis of further inquiry under the criminal provision of the statute. The commission finds that the rate charged was unreasonable, insofar as it exceeded $6 per ton. Reparation is therefore awarded. (21 I. C. C., 243.)

Lower Rates for Longer Haul Justified.

Roberts Cotton Oil Co. v. Illinois Central et al. Opinion by the commission:

Defendants maintain or participate in rates on cottonseed oil in carloads from St. Louis, Mo., and East St. Louis, Ill., to Chicago, Louisville, Ky., and Cincinnati, Ohio, which are relatively lower than the rates from Cairo Ill., to the same destinations; but the lower rates from St. Louis and East St. Louis are made by lines which do not reach Cairo, and defendants can not control the rates from those points. The rates from Cairo are not shown to be unreasonable, and defendants are not guilty of undue prejudice against that point within the meaning of section 3 of the act to regulate commerce. (21 I. C. C., 248.)

Reconsignment Charge Reduced.

Detroit Traffic Association v. Lake Shore & Michigan Southern et al. Opinion by Commissioner Lane:

The reconsignment charge of $3 per car exacted by defendants at Detroit, Mich., on bituminous coal originating at points in Ohio and elsewhere, and forwarded to various Michigan points, found to be unreasonable in itself, and a reconsignment charge of $2 per car prescribed for the future. (21 I. C. C., 257.)

STATE COMMISSIONS.

The Louisiana railway commission has been holding a series of hearings on the complaint against the service and physical condition of the Louisville & Nashville. The terminal facilities at New Orleans are especially attacked.

The Oklahoma corporation commission has decided that for a railway to issue passes to employees of baggage companies having contracts with the road for the transfer of baggage on through tickets, is not in violation of the anti-pass law of that state.

The Nevada Railroad Commission has issued an order reducing 1st, 2d, 3d and 4th class freight rates on the Southern Pacific and the Tonopah & Goldfield roads approximately 25 per cent. the reduction to go into effect August 1. The same commission has requested the Southern Pacific to appear July 12 at a hearing relative to a revision of passenger rates throughout the state.

The New York State Public Service Commission, second district, has authorized the Suffolk Traction Company to lay tracks at grade across the Long Island Railroad at Ocean avenue, Patchogue. The crossing must have approved interlocking signals and derails, and the expense of installation, maintenance and operation of the apparatus must be borne by the Suffolk company.

The Indiana Commission has issued an order (circular No. 77), calling the attention of the railways, both steam and electric, to the law requiring signs at all highway grade crossings, obedience to which has been neglected by some companies. At the session of the legislature this year a new and stronger law was passed and the commission notifies the railroads that offenders will be promptly prosecuted.

The New York State Public Service Commission, second district, has ordered the Newark & Marion to use only oil-burning

locomotives; and has refused the application of the company for an extension of three months from July 1 of the time within which it must comply with the order. The road was chartered as an electric line, but it was found that installation of electric apparatus would be too costly.

The Ohio Railroad Commission has ordered considerable reductions in the freight rates on coal from the Ohio coal field through Columbus north to Toledo. Heretofore the rate has been $1 per ton for all points north of Columbus. The commission has ordered the rates between Marion and Upper Sandusky cut from $1 to 75 cents; from Upper Sandusky to Fostoria from $1 to 80 cents, and from Fostoria, to Toledo from $1 to 85 cents. The Columbus rate was reduced from 65 cents to 60, and all rates south of Columbus were cut by five cents.

COURT NEWS.

In the Supreme Court of New York at New York City, a verdict of approximately $91,000 has been awarded against the Delaware & Hudson for loss on a fraudulent bill of lading. The suit was brought by Denike, assignee of claims of Keusch and others. It appears that the agent of the road, in collusion with shippers, had signed bills af lading for grain which never was shipped.

In the United States district court at Boston last week the Elm Farm Milk Company pleaded guilty on five of the sixty counts in the indictment which had been found against it for accepting reduced rates from the New York, New Haven & Hartford for the transportation of milk; and Judge Dodge imposed a fine of $5,000 and costs. The reports say that the railway company, indicted at the same time, pleads not guilty.

In the Circuit Court of Appeals at Little Rock, Ark., on June 26, Judge Trieber granted the state of Arkansas an appeal in the railway rate case, involving the validity of the 2-cent fares and freight tariffs of the state railway commission, which case he recently decided against the state, and ordered that tariffs fixed by the court and agreed on while the case was pending in the Circuit Court remain in force until a decision is reached by the Supreme Court of the United States.

The Supreme Court of New Jersey has decided that a manufacturer is liable for the negligence of his superintendent in instructing a workman to dress the wound of another employee. The employee had cut his finger with a pair of scissors and the superintendent told another workman to dress the finger, using carbolic acid taken from the emergency chest in the factory. Gangrene followed, and the injured man sued for damages, which were awarded him. The question involved on the appeal to the Supreme Court was whether the use of medicines found in an emergency chest in the factory was within the authority given by the superintendent to the man who dressed the injury.

The Supreme court of Indiana has sustained the order of the state railroad commission in ordering the elevation of tracks to separate the grades at a street crossing in Topeka, Ind. The railway company (the Wabash) denied the right of the commission to make such an order, claiming that the power lay in the hands of the town authorities, but the court, while holding that the town might act, holds that the railroad commission also has the power to act; and the order which was made by the commission in this case is held to have been reasonable and practicable. The right of a railway company to cross a public highway involves the duty of restoring the highway to its former condition of usefulness and safety; and if this cannot be done with the crossing at grade, then the company must elevate or depress.

In the federal court at Cincinnati, Ohio, Judge Hollister on June 30 fined three roads for keeping live stock in cars for more than 28 hours without water or stop, in violation of the interstate commerce act. Fifteen cases, for which it was fined $100 each, were decided against the Baltimore & Ohio Southwestern; three against the Queen & Crescent; and one, for which it was fined $200, was decided against the Big Four.

The Indiana Appellate Court, in the case of the Lakeshore & Michigan Southern vs. the Chicago, Lake Shore & South Bend, an electric line, has decided that an electric road is not liable for damages arising out of induced currents which interfere with the telegraph and telephone lines of a parallel steam road, unless it be shown that the electric line is not using the most improved methods to prevent induction.

Railway Officers.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

C. P. Crawford, auditor of the Erie Railroad, has been elected comptroller. J. G. Livengood, auditor of disbursements, succeeds Mr. Crawford, and C. E. Hildum succeeds Mr. Livengood, all with offices at New York.

J. F. Schaperkotter, general solicitor of the Lehigh Valley, with office at New York City, has resigned, and that position will be abolished, effective September 1. E. H. Boles has been appointed general attorney, with office at New Yorq City, in charge of the legal department.

Carl R. Gray, president of the Spokane, Portland & Seattle, has been elected also president of the Spokane & Inland Empire, succeeding J. P. Graves. C. A. Coolidge, general manager of the Oregon Electric Railway, has been appointed also vice-president, and general manager of the Spokane & Inland Empire, succeeding C. M. Graves, both with office at Spokane, Wash.

James Spicer Murray, who has been on the staff of the president of the Baltimore & Ohio, has been appointed assistant to president, with office at Baltimore, Md. Mr. Murray was born in 1871, at Baltimore, Md., and was educated at the Baltimore City College and then took a law course in the University of Maryland. He began railway work April 19, 1886, as a messenger boy in the master mechanic's office of the Baltimore & Ohio, and in 1889 was appointed a clerk in the office of the superintendent of motive power, at Mt. Clare. He was later promoted by Major H. D. Bulkley, late comptroller of the B. & O., to do special work in connection with the installation of system equipment valuation. On the completion of this work Mr. Murray was appointed private secretary to Comptroller Bulkley, remaining in that position until 1897, when he was made chief clerk to the comptroller. On January 1, 1904 he was promoted to a position on the staff of the president, to approve voucher payments and do special work, which position he held at the time of his recent appointment as assistant to president, as above noted. Mr. Murray's entire service has been with the Baltimore & Ohio.

James S. Murray

Incident to the reorganization and consolidation of the Cleveland, Akron & Columbus Railway Company and the Cincinnati & Muskingum Valley Railroad Company as the Cleveland, Akron & Cincinnati Railway Company (see item under Railway Financial news), Joseph Wood, who has been president, S. B. Liggett, secretary; T. H. B. McKnight, treasurer; and Robert R. Reed, assistant treasurer, of both companies, have been appointed to similar offices on the Cleveland, Akron & Cincinnati. S. C. Scott, vice-president of the Cleveland, Akron & Columbus, has been elected vice-president of the reorganized company, and the following officers of the Pennsylvania Lines West have had their jurisdiction extended over it: J. L. Mason, assistant secretary; J. J. Brooks, general counsel; C. B. Heiserman, general solicitor; A. P. Burgwin, assistant counsel, and G. C. Urquhart, real estate agent. John W. Renner, comptroller and J. T. Wellock, auditor, of the Cleveland, Akron & Columbus; and S. H. Church, assistant secretary of the Cincinnati & Muskingum Valley, have been appointed to similar positions on the Cleveland, Akron & Cincinnati.

Operating Officers.

W. M. Seeman has been appointed superintendent of dining cars of the San Pedro, Los Angeles & Salt Lake, with office at Los Angeles, Cal.

George E. Denklee has been appointed superintendent in charge of the accounting and operating departments of the Central Railway of Oregon, with office at Union, Ore.

Charles G. Richardson, traveling auditor of the Erie Railroad, has been appointed inspector of suburban service of the Erie and the New Jersey & New York, with office at Jersey City, N. J.

P. Laden, superintendent of the Indiana division of the Illinois Central, at Mattoon, Ill., has been appointed general manager of the Missouri, Oklahoma & Gulf, with office at Muskogee, Okla.

E. E. Lillie, superintendent of car service of the Spokane, Portland & Seattle, at Portland, Ore., has been appointed superintendent of the Spokane & Inland Empire, with office at Spokane, Wash., succeeding R. C. Bowdish, resigned.

C. T. Mason, assistant superintendent of the New Orleans, Texas & Mexico and the Beaumont, Sour Lake & Western, has been appointed superintendent, with office at Beaumont, Tex., succeeding H. Hall, assigned to other duties at Houston.

H. D. Voorhees, assistant to president Daniel Willard of the Baltimore & Ohio, has been appointed general superintendent of transportation of the Baltimore & Ohio system. A portrait of Mr. Voorhees and a sketch of his railway career were published in the *Railway Age Gazette* of May 20, 1910, page 1279.

T. H. Crump has been appointed trainmaster of the Canadian Pacific, in charge of Vancouver (B. C.) terminals, Westminster Junction and Westminster subdivision, and A. F. McIntyre has been appointed trainmaster in charge of the section from Vancouver to and including Kamloops, both with offices at Vancouver.

F. L. Sample, acting trainmaster of the Boston & Albany, at West Springfield, Mass., has been appointed trainmaster, in charge of the Albany division between Hinsdale and Athol Junction, including the Athol branch, with office at West Springfield. Charles A. O'Connor has been appointed chief train despatcher, and William B. Marshall has been appointed night chief train despatcher, both with offices at Springfield.

James B. Gilmer, assistant to general manager of the Texas Central, has been appointed assistant general manager in charge of the general manager's office, and his former position has been abolished. Ramsey M. Cox, superintendent, has been appointed assistant general manager, in charge of fire, personal injury, loss and damage and all other claims, also tax and right-of-way matters, and his former position has been abolished, both with offices at Waco, Tex.

Incident to the reorganization and consolidation of the Cleveland, Akron & Columbus and the Cincinnati & Muskingum Valley as the Cleveland, Akron & Cincinnati (see item under Executive, Financial & Legal Officers), W. B. Wood, superintendent of the Cleveland, Akron & Columbus, and Paul Jones, superintendent of the Cincinnati & Muskingum Valley, have been appointed to similar positions on the Cleveland, Akron & Cincinnati. A. B. Starr, general superintendent of freight transportation, and G. A. Cellar, superintendent of telegraph of the Pennsylvania Lines West, have had their jurisdiction extended over the reorganized company. F. C. Thayer has been appointed superintendent of the voluntary relief department; John F. Dodds, assistant superintendent of the voluntary relief department, and S. B. Liggett has been appointed superintendent of the employees' saving fund.

J. F. Murphy, who has been appointed general superintendent of the Missouri Pacific, with office at St. Louis, Mo., as was previously announced in these columns, was born April 6, 1870, at Peoria, Ill. He received his education in the common schools, and began railway work in August, 1887, as yard clerk for the Chicago & Alton. He was afterwards made a brakeman, and then switchman, and in 1889 went with the Kansas City, Fort Scott & Memphis, where he filled various positions in yard service until March, 1896, when he was made yardmaster of the Kansas City Suburban Belt. He was later promoted to general yardmaster, then to terminal trainmaster, and to superintendent, leaving that road in October, 1905, to become trainmaster of the Missouri Pacific at Coffeyville, Kan. In February, 1907, he was appointed superintendent of the Memphis division, was later transferred to the Central and Arkansas divisions, and on June 19 of this year was promoted to general superintendent of the eastern district.

George S. Cooke, who has been appointed superintendent of the Grand Trunk Pacific, with office at Melville, Sask., as has been announced in these columns, was born October 27, 1875, at Montreal, Que. He was educated in the schools of Montreal, and in 1890 began railway work with the Grand Trunk System at Montreal, first as a clerk in the stationery department and then in the superintendent's and trainmaster's office. He was appointed chief clerk to the trainmaster at Battle Creek, Mich., in February, 1900, and in October of the following year was made chief clerk to the superintendent of the St. Louis, Iron Mountain & Southern. In March, 1905, he went with the Chicago, Cincinnati & Louisville, first as chief clerk to the superintendent and then to the general superintendent, and became trainmaster at Peru, Ind., in August, 1906. A year later he was made chief clerk in the engineering department of the Grand Trunk Pacific, and from October, 1908, until the time of his recent promotion he was trainmaster at Melville.

James F. Russ, whose appointment as superintendent of the Missouri Pacific, with office at Atchison, Kan., has been announced in these columns, was born August 11, 1861, at Kewanna, Ind. He was educated in the public schools and began railway work in November, 1878, in the operating department of the Pittsburgh, Cincinnati & St. Louis, now part of the Pennsylvania system. In 1884 he went with the Kansas City, Fort Scott & Memphis, and was with that company continuously, first as despatcher and then as chief despatcher, until 1892, except during the year 1891, when he was trainmaster of the New York & New England, now part of the New York, New Haven & Hartford. For three years prior to September, 1895, he was with the New York, Ontario & Western as trainmaster at Carbondale, Pa., and he was then out of railway work until April, 1900, when he became trainmaster of the Kansas City, Fort Scott & Memphis and the St. Louis & San Francisco. He was superintendent of the Chicago & Eastern Illinois for two years from March, 1903, and from 1905 to 1907 he was again out of railway work. In the latter year he was made despatcher of the Missouri Pacific, was promoted to trainmaster in August, 1908, and is now advanced to superintendent as above.

Traffic Officers.

S. G. Yerkes has been appointed agent of the Chicago Great Western, with office at Fargo, N. D., succeeding G. L. Williams, resigned.

H. E. Woodworth has been appointed a freight soliciting agent of the Southern Railway, with office at Nashville, Tenn.

R. L. Castleberry has been appointed traveling freight agent of the Erie Despatch, with office at Dallas, Tex., succeeding C. D. Young, resigned.

W. H. Shorey, passenger and ticket agent of the Wabash at Fort Wayne, Ind., has been appointed division passenger agent, with office at Fort Wayne.

P. J. Rose, contracting freight agent of the Chicago & Alton and the Toledo, St. Louis & Western, has been appointed a traveling freight agent, with office at St. Louis, Mo.

C. E. Redman has been appointed traffic manager of the Las Vegas & Tonopah, with office at Goldfield, Nev., succeeding J. H. Brown, resigned to go into other business.

L. M. Shepardson has been appointed contracting freight agent of the Illinois Central, with office at St. Louis, Mo., succeeding D. L. Hyde, resigned to engage in other business.

Edward L. Pardee has been appointed assistant general passenger agent of the Chicago, St. Paul, Minneapolis & Omaha, with office at St. Paul, Minn., succeeding G. M. MacRae, promoted.

Leo M. Schachtmeyer, chief clerk in the San Diego, Cal., office of the Atchison, Topeka & Santa Fe, has been appointed a traveling passenger agent of the Southern Pacific, with office at San Diego.

H. B. Sperry, commercial agent of the Colorado & Southern at Ft. Worth, Tex., has been appointed general freight and passenger agent of the Texas Central, with office at Waco, Tex., succeeding W. F. McMillin, resigned.

R. R. Bilter has been appointed a commercial agent of the Chesapeake & Ohio and the Chesapeake & Ohio of Indiana, with office at Kansas City, Mo., and J. Shaw Stevens has been appointed a commercial agent, with office at Los Angeles, Cal.

Effective August 1, the headquarters of C. T. Wight, division freight agent of the Baltimore & Ohio at Sandusky, Ohio, will be transferred to Fostoria, Ohio, and G. F. Leingang, chief clerk to the division agent at Sandusky, will be appointed a division freight agent at that place.

D. L. Ewing, general agent in the freight department of the St. Louis & San Francisco at Pittsburgh, Pa., has been appointed assistant general freight agent, with office at St. Louis, Mo., succeeding Charles Hall, transferred. R. B. Merrick, commercial agent at New York City, succeeds Mr. Ewing, and A. W. Von Arx succeeds Mr. Merrick.

E. R. Jennings, traveling passenger agent of the Missouri Pacific at Little Rock, Ark., has been transferred to Chattanooga, Tenn., succeeding B. K. Quick, resigned to go into other business. W. H. Glover succeeds Mr. Jennings, and H. C. Halverson has been appointed a traveling passenger agent at Little Rock, succeeding G. M. Trickett, assigned to other duties.

H. C. Webb, traveling passenger agent of the Illinois Central at Houston, Tex., has been appointed a district passenger agent; C. L. Chase has been appointed a traveling freight agent; and T. F. Bowes has been appointed a traveling freight and passenger agent, all with offices at Houston. Hugh Hardin, soliciting freight agent at Dallas, Tex., has been appointed a traveling freight agent with headquarters at Dallas. J. F. Merry, general agent at Manchester, Iowa, has retired on a pension.

J. Warren Brown, traveling freight and passenger agent of the El Paso & Southwestern at St. Louis, Mo., has been appointed southeastern freight and passenger agent, with headquarters at Memphis, Tenn., a new office. J. L. Fox, traveling freight and passenger agent at Pittsburgh, Pa., succeeds Mr. Brown. J. F. Hogan, contracting agent of the Illinois Central at Chicago, has been appointed traveling freight and passenger agent of the El Paso & Southwestern, with office at Chicago.

Edward S. Giles, who has been appointed assistant general freight agent of the Delaware, Lackawanna & Western, with offices at New York City, as has been announced in these columns, was born August 18, 1873, at Plainwell, Mich. He began railway work with the Delaware, Lackawanna & Western on October 2, 1890 as a clerk, and was later chief rate clerk, and in September, 1906, he was promoted to chief of tariff bureau, which position he held at the time of his recent appointment as assistant general freight agent.

John O. Goodsell, traveling passenger agent of the Union Pacific and the Southern Pacific at Toronto, Ont., has been appointed traveling passenger agent, with office at Detroit, Mich., succeeding A. J. Ratcliffe, deceased. Fred V. DeFriest has been appointed contracting freight agent, with office in New York City, succeeding Daniel C. Fisk, transferred, and John P. Plummer has been appointed a contracting freight agent, with office at San Francisco, Cal. Max Meadors has been appointed a contracting freight agent, with office at Los Angeles, Cal., succeeding W. J. Robinson, deceased.

George W. Stahlman, agent of the Union Line of the Pennsylvania Lines West at Memphis, Tenn., has been transferred to Nashville, Tenn., succeeding D. A. Lindsey, resigned. William C. Wood, Jr., traveling freight solicitor at St. Paul, Minn., succeeds Mr. Stahlman, and I. C. Furber, agent at Fargo, N. D., succeeds Mr. Wood. A. F. Ferguson, traveling freight solicitor at St. Paul, succeeds Mr. Furber at Fargo. Walter M. Wallace, freight solicitor at St. Paul, has been appointed a traveling freight solicitor at St. Paul, succeeding W. P. Cameron, who in turn, succeeds Mr. Ferguson. John J. Fee, Jr., succeeds Mr. Walker.

Incident to the reorganization and consolidation of the Cleveland, Akron & Columbus and the Cincinnati & Muskingum Valley as the Cleveland, Akron & Cincinnati (see item under Executive, Financial & Legal Officers), J. M. Chesbrough, general passenger agent, and F. E. Sawyer, general freight agent, of the Cleveland, Akron & Columbus, have been appointed to similar positions on the Cleveland, Akron & Cincinnati. Thomas S. Trainer, general freight and ticket agent of the Cincinnati & Muskingum Valley, has been appointed division freight agent; and R. R. Bentley, general baggage agent of the Pennsylvania Lines West, has had his jurisdiction extended over the new company.

Engineering and Rolling Stock Officers.

Millard F. Cox has been appointed mechanical engineer of the Louisville & Nashville, with office at Louisville, Ky., succeeding W. A. Stearns, resigned.

R. H. Collins has been appointed inspector of roundhouse and shop efficiency of the St. Louis & San Francisco, with office at Springfield, Mo.

N. G. Rich, roadmaster of the Missouri, Kansas & Texas of Texas, with headquarters at Granger, Tex., has resigned to accept service with another company.

J. H. Burger has been appointed roadmaster of the Southern division of the Gulf, Colorado & Santa Fe, with office at Lampasas, Tex., succeeding D. H. Watson.

G. W. Deats, general foreman of shops of the Texas & Pacific at Fort Worth, Tex., has been appointed master mechanic of that road and the International & Great Northern, with office at Fort Worth, a new position.

C. M. Hoffman, superintendent of motive power of the St. Louis, Brownsville & Mexico, with office at Kingsville, Tex., has had his jurisdiction extended over the New Orleans, Texas & Mexico, the Beaumont, Sour Lake & Western and the Orange & Northwestern.

C. N. Monsarrat and C. C. Schneider, formerly engineers in the service of the Canadian Pacific, are now members of the board of engineers in charge of the construction of the Quebec bridge across the St. Lawrence. Mr. Monsarrat recently resigned the position of chief engineer of bridges of the Canadian Pacific. Mr. Schneider was designer of important bridges on that road when its line to the Pacific was built, one of these being the cantilever bridge over the Fraser river in British Columbia.

Charles E. McAuliffe, whose appointment as master mechanic of the Missouri Pacific, with office at Atchison, Kan., has been announced in these columns, was born February 27, 1871, at St. Johns, Mich. He received a public school education and in December, 1887, began work with the Grand Trunk Railway. He remained with that road until 1899, doing shop work two years, acting as fireman six years and was for four years an engineer. He then became an engineer on the Great Northern, and in 1904 was appointed a traveling engineer of the Missouri Pacific. He was promoted to assistant master mechanic at Sedalia, Mo., in February, 1911, from which position he is now advanced to master mechanic of the Northern Kansas division.

Wilmer Herbert Sample, whose appointment as master mechanic of the Ottawa division of the Grand Trunk, with office at Ottawa, Ont., has been announced in these columns, was born August 20, 1864, at Altona, N. Y., and was educated at the Plattsburg High School. He began railway work on July 20, 1882, as a fireman on the Central Vermont, and was promoted to engineer in 1886. He resigned in July, 1887, to go to the Atchison, Topeka & Santa Fe in the same capacity, and in August, 1889, returned to the Central Vermont as engineer. In February, 1901, he was promoted to road fore-

man, and in July, 1906, he went to the Northern Railway of Costa Rica, Central America, as superintendent of motive power and car departments, from which position he resigned to go to the Grand Trunk, as above noted.

As noted last week in these columns, Theodore N. Ely, heretofore chief of motive power of the Pennsylvania Railroad, retired from railway work on July 1, after 43 years of service. He was born on June 23, 1846, at Watertown, N. Y., prepared for college in the excellent public schools of that village, and graduated from Rensselaer Polytechnic Institute in 1866 as a civil engineer. Immediately after graduation he was engaged as an engineer at the old Fort Pitt foundry at Pittsburgh, experimenting with projectiles under Gen. Rodman. A year later, 1867, he was at work in the mining operations in the Monongahela river region. In 1868 he entered upon his life's work and long career in the service of the Pennsylvania Railroad as an engineer on the Pittsburgh, Fort Wayne & Chicago at Pittsburgh, from which he was soon sent as asistant engineer to the Philadelphia & Erie division of the Pennsylvania. From 1869 to 1870 he was superintendent of the middle division of the Philadelphia & Erie, and was then promoted to asistant general superintendent, a position which he held until 1873. From 1873 to 1874 he was superintendent of motive power of the same division. In 1874 he was made superintendent of motive power of the Pennsylvania Railroad division, and in 1882 became general superintendent of motive power of the Pennsylvania Lines East of Pittsburgh and Erie. From March, 1893, to the date of his retirement he has been chief of motive power, Pennsylvania Lines East and West of Pittsburgh and Erie.

Theodore N. Ely

Mr. Ely is a member of the American Society of Civil Engineers, the Institution of Civil Engineers (England), the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the Franklin Institute, the American Philosophical Society, the American Association for the Advancement of Science, and other technical and scientific associations; vice-president of the American Academy in Rome, and an honorary member of the American Institute of Architects. He is president of the Eastern Railroad Association, and is a member of the executive committee of the American Railway Association and of the permanent commision of the Internationai Railway Congress. He is a member of the board of directors of the Pennsylvania Steel Company and the Cambria Steel Company and of the boards of trustees of the Drexel Institute of Art, Science and Industry, and of the Philadelphia Commercial Museum. The honorary degree of Master of Arts was conferred upon Mr. Ely in 1897 by Yale University, and that of Doctor of Science by Hamilton College in 1904.

Mr. Ely was a bold originator, and yet possessed of a boldness so tempered with caution and certainty that his mistakes were few indeed as compared with his achievements. He never hesitated to launch out into the untried, yet he was never carried away by impulse, but guided his craft with cool calculations. It was Mr. Ely that took the first step, alone, against the protests of many by whom he was surrounded, that has led to the development of the large locomotives of today. While builders and engineers considered that the end had come, that the locomotive had reached the limit of its power, because of the restrictions current construction put upon the size of the firebox; Mr. Ely lifted his whole boiler into the air, set his foundation ring on top of the frames, widened his firebox and gave the machine a new lease of life. Many and dire were the predictions made as to the instability of the new design. But we all know the result. It did not upset, but ran with unexampled smoothness; and with construction revolutionized the whole country followed in his wake. This is but a single example of his work. Mr. Ely's success was so based on sound discrimination and careful consideration, that, to a wonderful degree, he gained and held the confidence of all who came in contact with him. As one of his associates expressed it, he was the balance wheel of the mechanical organization of the road; and if these same associates are to be believed it is to his influence that the wonderful team work of the various departments is largely due. No man could have gained the reputation for clear judgment that Mr. Ely possesses, among all who know him, who has not merited it; and the position which he holds in the opinions of his associates speaks volumes for the character of the man and his work.

Purchasing Officers.

C. H. Rost, district storekeeper of the Rock Island Lines, at Shawnee, Okla., has been appointed stationer, with office at Chicago, succeeding W. K. Wayland, resigned.

OBITUARY.

John Rutherford, formerly trainmaster of the Chicago, Burlington & Quincy, died at his home at La Grange, Ill., on June 29.

Franklin A. Wilson, formerly president of the Maine Central, a director in many Maine corporations and president of the Penobscot County Bar Association, died at Bangor, Me., on July 2, at the age of 78 years.

W. L. Pierce, superintendent of the Richmond division of the Southern Railway, with office at Richmond, Va., died at that place on June 29, at the age of 49 years. Mr. Pierce had been with the Southern Railway and its predecessors for 33 years.

A. F. Merrill, assistant general passenger agent of the Chicago, Milwaukee & St. Paul, with office at Chicago, died in that city on June 26. Mr. Merrill began railway work with the Chicago, Milwaukee & St. Paul in 1867, and was in the service of that road continuously until his death, having been clerk for two years, chief clerk of ticket accounts 11 years, and assistant general passenger agent since 1880.

FOREIGN RAILWAY NOTES.

The Department of Industry and Public Works has approved the definite project of the Cajon to Llaima Railway, covering a distance of about 27 miles.

The Quillacollo to the valley of Cliza electric railway in Argentina, with terminal stations at Vinto and Arani, has a total length of 56 miles. The construction of the first section of this important electric line has been completed and work on the second section, which will extend to the fertile and beautiful Cliza valley, will soon be begun. The survey of this railway extends in an easterly direction to Las Cuadras, and from there runs southward to the Cliza valley, crossing the public highway at Angostura. The completion of this much needed electric railway will greatly accelerate the development of the rich country through which it passes and will exert a beneficial influence on the agricultural and mining industries of the neighboring regions.

A retired engineer officer of the Prussian State Railway discussed before a scientific railway society the question of the relative durability of timber and iron cross-ties. The life of wooden ties of different kinds of timber, and with different kinds of preservative treatment, is pretty well known; but metal ties, though long in use, have not shown such definite results, largely because it has been found necessary to change the patterns before they were absolutely useless. But the speaker had examined and measured the wear or corrosion of many of these; he showed photographs and explained his methods, and came to the conclusion that a steel tie has no longer life than a preserved pine tie, or very little longer. The modern metal tie, he estimates, will last 16 years, while the life of the preserved timber ties is 15 years.

Equipment and Supplies.

LOCOMOTIVE BUILDING.

THE GREAT NORTHERN has ordered 20 mikado locomotives from the Baldwin Locomotive Works.

THE MISSOURI PACIFIC has ordered 50 mikado locomotives from the American Locomotive Company.

THE LEHIGH & NEW ENGLAND has ordered 2 consolidation locomotives from the Baldwin Locomotive Works. The dimensions of the cylinders will be 23½ in. x 30 in., the diameter of the drivers will be 57 in., and the total weight in working order will be 228,000 lbs.

THE ILLINOIS CENTRAL has ordered 10 mikado locomotives from the Baldwin Locomotive Works. These locomotives will be identical with the 40 which were mentioned in the *Railway Age Gazette* of March 10; this company has also ordered 10 Pacific type superheater locomotives from the American Locomotive Company.

THE ATCHISON, TOPEKA & SANTA FE, as mentioned in the *Railway Age Gazette* of June 30, has ordered 81 locomotives from the Baldwin Locomotive Works. This order includes 24 coal burning Mallet locomotives, 17 oil burning switching locomotives, 12 coal burning switching locomotives, 15 coal burning Pacific type locomotives and 13 oil burning Pacific type locomotives.

CAR BUILDING.

THE ANN ARBOR is in the market for about 450 freight cars.

THE CHICAGO & EASTERN ILLINOIS is in the market for 4 coaches, 2 chair cars and 2 buffet lounging cars.

THE MISSOURI PACIFIC is sending out inquiries for 50 passenger cars. Specifications have not yet been completed.

THE ST. LOUIS & SAN FRANCISCO is in the market for 2 baggage cars, 3 combination mail and baggage cars, 3 coaches, 6 chair cars and 1 dining car. In addition to the above this company together, with the Chicago & Eastern Illinois, expects in a short time to buy 35 all steel exterior, wood finish interior, 70-ft. passenger cars.

IRON AND STEEL.

THE SOUTHERN RAILWAY is in the market for 20,000 tons of 80-lb. rails.

THE GREAT NORTHERN has ordered 3,000 tons of rails from the Illinois Steel Company.

THE CANADIAN PACIFIC has ordered 30,00 tons of rails from the Illinois Steel Company.

THE GREAT NORTHERN has ordered 436 tons of structural steel for a machine shop in Hillyard, Mont.

THE WHEELING & LAKE ERIE has ordered 800 tons of bridge material from the King Bridge Company.

THE LOUISVILLE & NASHVILLE has ordered 3,800 tons of bridge material from the American Bridge Company.

THE CHATTANOOGA & ST. LOUIS has ordered 1,050 tons of rails from the Tennessee, Coal, Iron & Railroad Company.

THE HASKELL & BARKER CAR COMPANY is reported to have ordered 2,500 tons of structural material to be used in its new car building plant at Michigan City, Ind., from the American Bridge Company.

GENERAL CONDITIONS IN STEEL.—Although the orders booked during the closing days of June did not quite equal those of the previous week, the opening days of July were satisfactory and everything points toward a prosperous month. Some large orders that were expected in June were held up; but they are still pending and will probably be placed this month. Export business is large, especially in street railway requirements for Central and South America. The industry continues to operate at about 70 per cent. of its capacity.

Supply Trade News.

The Hale & Kilburn Company, New York, has moved its Chicago office from the Fisher building to the McCormick building.

W. G. Willcoxson has been made sales manager of the Grip Nut Company, Chicago, with headquarters in the Old Colony building.

McClernan & Co., Chicago, dealers in iron and steel, have moved their offices from the Monadnock block to the Peoples Gas building.

The Roberts & Schaefer Co., Chicago, recently secured a contract from the Oregon-Washington Railroad & Navigation Company for designing and building two Holmen locomotive coaling stations. One plant is to be installed at the Argo roundhouse at Seattle, Wash., and is to be of 500 tons capacity with sand equipment. The other is to be installed at the new roundhouse at Tacoma, and is to be of 100 tons capacity. The approximate contract price for the above plants is $30,000.

John P. Sykes, assistant general superintendent of the Baldwin Locomotive Works, Philadelphia, Pa., has been made general superintendent of the company, succeeding S. M. Vauclain, who held that position for the past 26 years, and who has now become vice-president. Mr. Sykes was born in Charlotte, N. C., on September 25, 1860. He attended school in Delaware county, Pennsylvania, and also in Philadelphia. He also took a course in a business college. Mr. Sykes entered the employ of the Baldwin Locomotive Works in May, 1879, in the sheet iron department of the Seventeenth street shops. After serving his apprenticeship, he was rapidly promoted from one position to another, until finally he assumed charge of the tank department. Later he was promoted to the position of assistant general foreman of the same shop and soon after was made night superintendent of the entire plant. When the Baldwin Locomotive Works purchased the ground at Eddystone for its new plant, Mr. Sykes was chosen to take charge not only of the erection of the new buildings required but of all the manufacturing as well, under the title of superintendent of the Eddystone plant. After the Eddystone plant was in complete working order it was decided to transfer Mr. Sykes to the Standard Steel Works Company, Burnham, Pa., as general superintendent, which plant is owned and operated by the Baldwin Locomotive Works. Last year he was returned to Philadelphia to take the position of assistant general superintendent of the Baldwin Locomotive Works, thus relieving Mr. Vauclain of some of his duties, and now upon the reorganization of the company has been made general superintendent of the works.

J. P. Sykes.

TRADE PUBLICATIONS.

KEWEENAW CENTRAL.—This company has published a small booklet entitled Beautiful Keweenaw, which contains a map and full descriptions of the Keweenaw peninsula in upper Michigan.

VENTILATING SETS.—The American Blower Co., Detroit, Mich., has published a small booklet on Sirocco electric venti-

lating sets giving neat descriptions, illustrations and diagrams of Sirocco fans and air purifiers. Tables are included.

Paints.—Cheesman & Elliot, New York, have published the eighth edition of The Review of Technical Paints. This booklet analyzes the causes of paint decay and describes the different kinds of paints, telling to what uses they are best adapted.

Earth Handling Machinery.—The Western Wheeled Scraper Company, Aurora, Ill., has devoted a very full catalog to descriptions and illustrations of its many types of scrapers, plows, earth-handling cars and wagons, crushers, graders, etc. The booklet contains over 125 pages and list prices and dimension tables are included.

Forging and Bending Presses.—The Mesta Machine Company, Pittsburgh, Pa., has issued a well illustrated catalog of its steam-hydraulic forging and bending presses. Besides the illustrations, the booklet gives a general description, the principal advantages and the specifications of these presses. The illustrations show installations of the different types in foundries, both at home and abroad.

Electric Trucks.—The Automatic Transportation Co., Buffalo, N. Y., has published a catalog of its electric trucks for handling package freight at railway and steamship terminals and other institutions which require hand trucking about the premises. It is claimed that the operation of these trucks involves a great saving compared with hand trucking. The descriptions and the illustrations in the catalog are good.

Generators and Switchboard Panels.—The General Electric Company, Schenectady, N. Y., describes in Bulletin No. 4,832, a line of commutating pole generators in which it is claimed that commutating trouble is eliminated. These generators are built for slow and moderate speeds, and range in capacity from 20 to 150 k. w. Bulletin No. 4,846 describes switchboard panels and points out the uses to which the various types are particularly adapted.

Southern Railway.—The passenger department of this road recently completed three small booklets on North Carolina, South Carolina and Virginia. Each booklet contains about 35 pages and gives a surprising amount of information on all the principal resources, industries and distinguishing characteristics of the state. Many of the more important towns are briefly described, together with the opportunities they offer. While they are intended for the prospective homeseeker and investor, these booklets cover their field so thoroughly that they will be found of great value to all who are interested in the development of the South.

A Prussian railway has two water stations on the river Mulde. The water taken at Eilenburg leaves a slight incrustation in the boiler, while the water at Bitterfeld not only forms no incrustation, but when used in boilers which were previously foul it very soon dissolves the deposit so that it can easily be blown out, though the tubes leak afterwards sometimes. On this account the Bitterfeld station has come to be called the "engine dispensary." Analysis of the waters at the two stations showed there was the same amount of solid constituents in each, but that the Bitterfeld water contained also some free carbonic acid gas, probably coming from springs which have an outlet near the water station. Acting on this hint the engineer, Klopsch, obtained a carbonic acid gas holder, such as are kept in beer saloons there, but here are better known for their use in soda-water fountains. He fitted this with a reducing valve, through which the gas could be made to escape very slowly, and attached to it tanks where the water produces much incrustation, adjusting the valve so that no bubbles escaped from the surface of the water. Soon the deposit at the bottom of the tank increased, and incrustation in the boilers fed with this water decreased; the incrustation which had accumulated before was more easily detached and could be almost entirely washed out by water at a high pressure. Investigation of the interior of the boilers so fed showed no injurious effects. The leaking of tubes, which had been common theretofore, disappeared almost entirely. The purification of the water at these stations by the use of lime, soda and barytes was costlier, and not infrequently was followed by foaming, and injured the cylinders. Mr. Klopsch thinks, therefore, that the carbonic-acid gas treatment deserves a more extended trial.

Railway Construction.

New Incorporations, Surveys, Etc.

California Roads (Electric).—W. G. Kerckhoff, Los Angeles, Cal., will build an electric line, it is said, from San Bernardino west to Upland, about 22 miles, if right-of-way is granted.

Canadian Northern.—According to press reports, a contract has been given to P. Welch & Co., for building about 165 miles of the line between Hope, B. C., on the Fraser river, and Kamloops, covering the entire Fraser river canyon. Work is under way on the section from Port Mann, B. C., on the Pacific coast east to Hope, 80 miles. The contract calls for the completion of this work within two years. Between Edmonton, Alb., and Yellow Head Pass work is also under way, but there remains a section of about 250 miles through the mountains between Kamloops, B. C., and Yellow Head Pass, for which contracts have not yet been let. (May 12, p. 1132.)

Canadian Northern Ontario.—Contracts for completing the Ottawa, Ont.-Toronto line have been let, it is said, as follows: To McDonald & Chism, for work from Hurdman's bridge to the Rideau river, at Hogs Back; H. Cristin, from the river towards Richmond; to contractor Bonneville for that part from the end of Cristin's division into Richmond, and to P. J. Brennan, from Richmond, west to Smiths Falls. It is expected that work on the line will be finished this year.

Canadian Pacific.—According to press reports, bids are wanted to build a branch from Duncan, B. C., on the Esquimalt & Nanaimo, to Cowichan lake, 25 miles. The company expects to have the work finished within six months.

Esquimalt & Nanaimo.—See Canadian Pacific.

Grand Trunk.—The Southern New England, recently organized to build the Grand Trunk extension to Providence, R. I., has filed a plan of its route from Palmer, Mass., to Providence, R. I. Under the terms of the charter the line must be completed by 1915. A large terminus is to be built in the central part of Providence. There will be a bridge over the New York, New Haven & Hartford, freight yards and a tunnel under Capitol hill. (May 12, p. 1133.)

Gulf, Florida & Alabama.—An officer writes that grading work is now under way by Charles Merritt, Pensacola, Fla., on the first section, and other sections are ready to be let. The plans call for a line from Pensacola, north via Thomasville, Ala., Linden, Demopolis and Tuscaloosa to Jasper, about 250 miles. Maximum grades will be 0.75 per cent., and maximum curvature 5 degrees. There will be steel bridges over the Alabama and Warrior rivers and a station and piers, at Pensacola, Fla. The line is being built to carry agricultural products, coal, lumber, steel cotton and naval stores. R. C. Megargel, president, New York, and G. A. Berry, chief engineer, Pensacola, Fla. (May 19, p. 1187.)

Harriman, Knoxville & Eastern.—An officer writes that work is now under way by the McDowell Construction Company, Knoxville, Tenn., building a section of 17.5 miles of main line, and three miles of sidings. The grading work involves handling about 30,000 cu. yds. to the mile. Maximum grades eastbound will be 0.65 per cent. compensated, and maximum curvature 6 deg. It is expected to have the work completed about August 1. The plans call for a line from Harriman, Tenn., east via Knoxville, thence to a point in North Carolina. Contracts were let July 3, for building a combined freight and passenger station at Harriman, Tenn. S. E. Hendrick, president, and W. J. Clarke, chief engineer, Harriman. (November 4, p. 887.)

Houston & Texas Central.—An officer writes that contracts are to be let soon to build from Stone City, Tex., via Caldwell to Lincoln or Giddings. There will be five steel bridge varying in length from 60 to 500 ft. each.

Idaho Roads (Electric).—W. E. Pierce, Boise, Idaho, is said to be interested in a project to build from Caldwell, Idaho, southeast to Nampa, about 10 miles. Right-of-way has been secured and work will be started soon.

KEARNEY & BLACK HILLS.—See Union Pacific.

KOOTENAY & ALBERTA.—An officer writes that work is now under way by Grant, Smith & Co., Spokane, Wash., from a point one mile west of Pincher, Alb., southwesterly, about 13 miles. The work will be heavy. The line is being built to carry coal from the Western Coal & Coke Company's mines, also wheat. L. B. Merriam, chief engineer, 125 Phoenix building, Winnipeg.

LAWTON & ARDMORE.—According to press reports, arrangements have been made with the Development Corporation of Philadelphia, Pa., to build from Lawton, Okla., southeast to Ardmore, about 80 miles, on which work is expected to be started at once. The line is eventually to be extended southeast from Ardmore to Sherman, Tex., in all about 125 miles. R. L. Robertson and J. L. Hamon, Lawton, Okla., are interested.

MINNESOTA, DAKOTA & WESTERN.—An officer writes that this company is planning to build about 150 miles of extensions. The company now operates a freight line from International Falls, Minn., south, thence west to Loman, 23 miles; also 4.5 miles between International Falls and Falls Junction, and the International bridge between Fort Frances, Ont., and International Falls, Minn., with terminals at International Falls.

NEW YORK SUBWAYS.—See an item regarding new subway in General News section.

PACHUCA, ZIMAPAM & TAMPICO.—This company, which is building from Pachuca, Mex., to Tampico, has finished the work into the Actopan district it is said, and work on the extension to Tampico will be pushed to completion. Richard Honey, a wealthy iron manufacturer and banker of Mexico is back of the project.

SOUTHERN NEW ENGLAND.—See Grand Trunk.

SOUTHERN RAILWAY.—An officer writes that this company is going to carry out some double-track work north of Atlanta, Ga., for which contracts were recently let as follows: Lane Brothers Co., Altavista, Va., from Oakwood, Ga. to Buford, 11 miles; C. W. Lane & Co., Atlanta, from Buford to Suwanee, seven miles, also from Duluth to Pittman, three miles, and to M. M Elkan, Macon, from Pittman to Cross Keys, 12 miles. The work is being carried out in two sections, one extending from Oakwood to Suwanee, and the other from Duluth to Cross Keys, there being a gap of about five miles between the two sections. The improvements include some grade and alinement revision. (May 26, p. 1223.)

TEXAS ROADS (ELECTRIC).—The Stone & Webster Engineering Corporation, which is preparing to construct an electric line between Dallas, Tex., and Waxahachie, about 30 miles, will soon finish securing the right-of-way and will then let the contract for construction work. The proposed line is ultimately to be extended south to Waco and Corsicana. Preliminary steps towards carrying out this work are now in progress. It is understood that the Stone & Webster interests will build a north and south interurban electric line that will reach from Sherman on the north and to Galveston on the south. The same interests are now constructing a line between Houston and Galveston, 51 miles, which will form part of the proposed line through the state.

S. A. Robertson, San Benito, Tex., and associates, who are constructing a system of interurban lines to be operated by gasolene motor cars out of San Benito, have enlarged their plans. The first 40 miles of the line was recently opened for passenger and freight traffic, it is said. Arrangements have been made for constructing immediately about 60 miles additional. The line is already finished to within eight miles of Brownsville. The St. Louis & San Francisco is asid to be back of the project.

UNION PACIFIC.—This company has begun work on a 34-mile extension, it is said, of the Kearney & Black Hills, from Callaway, Neb.

RAILWAY STRUCTURES.

BENTON HARBOR, MICH.—The Cleveland, Cincinnati, Chicago & St. Louis is rebuilding the six-stall roundhouse which was burned last April. Construction work was started July 1.

CAPE GIRARDEAU, MO.—The St. Louis & San Francisco, it is reported, will build a $35,000 passenger station at this place.

CHAMPAIGN, ILL.—The Illinois Central has awarded the contract, it is said, for the construction of a 25-stall roundhouse and for the equipment, also for a machine shop and coal chutes.

CHICAGO.—The Minneapolis, St. Paul & Sault Ste. Marie has started condemnation suits for the property between Canal and Clinton streets, extending from Twelfth to Sixteenth streets. The property is to be used for freight tracks and a freight terminal.

CLAYBURN, B. C.—See Taft, B. C.

DAVIS ISLAND, PA.—The Pittsburg & Lake Erie is said to have awarded the contract for the repair shops to be built at this place.

FRIENDSHIP, WIS.—See Wyeville, Wis.

HARRIMAN, TENN.—See Harriman, Knoxville & Eastern under Railway Construction.

MATSQUI, B. C.—See Taft, B. C.

MEMPHIS, TENN.—The Missouri Pacific is said to be contemplating the building of a bridge over the Mississippi river at Memphis.

MILES CITY, MONT.—The Northern Pacific has awarded the contract for building a freight house 40 ft. x 120 ft., to cost about $12,000.

MORRISTOWN, TENN.—The Southern Railway will put up a new station at Morristown, it is said. The work is to be carried out by the company's men, and is expected to be finished by October 1.

NEW HAVEN, CONN.—The New York, New Haven & Hartford is building at the Cedar Hill freight yards a large reinforced concrete roundhouse. It is to be 360 ft. in diameter and will provide stalls for 43 steam or 86 electric engines. The roofed ring which houses the engine is 90 ft. wide and 30 ft. high. The central open area is 90 ft. in diameter, and in the center is a 75-ft. turntable. Each engine stall has a pit, and three have drop pits for repair work.

NEW YORK.—The New York, New Haven & Hartford is putting up a brick warehouse, two stories high, 38 ft. x 1,021 ft., at Willis avenue and 132nd street, New York. William Henderson, New York, is the contractor.

ROCK HILL, S. C.—The Southern has let contracts for building a pressed brick, tile roofed, steam heated passenger station to cost about $35,000.

ST. LOUIS, MO.—The Manufacturers Railway of St. Louis will build a union freight house and office building on Broadway and Miller street. The building is to be 60 ft. x 300 ft., eight stories high and of brick and steel fireproof construction. The terminal tracks will have a capacity of 120 cars.

SOUTH CHICAGO, ILL.—The Pennsylvania Lines West has awarded the contract for building a one and two story brick and stone freight house 30 ft. x 16.1 ft.

TACOMA, WASH.—The Chicago, Milwaukee & Puget Sound will start work at once on a dock to be built on the tidelands at Tacoma, at an estimated cost of $50,000.

TAFT, B. C.—The Canadian Pacific is asking for bids to build new stations at Taft, Matsqui, Clayburn and Vernon.

VERNON, B. C.—See Taft, B. C.

WACO, TEX.—The Texas Central's coach sheds were recently destroyed by fire, the estimated loss being $40,000, which was partially covered by insurance. This company will probably build a fireproof structure in the near future.

WALLA WALLA, WASH.—The Northern Pacific will build a new station, it is said, at Walla Walla, to cost $50,000, and is having plans made for new car shops, roundhouses and additional trackage at Pasco.

WYEVILLE, WIS.—The Milwaukee, Sparta & North Western has awarded the contracts for building one-story, 18-stall roundhouses of brick and steel construction at Wyeville and Friendship, Wis.

Railway Financial News.

Belt Railroad & Stock Yards (Indianapolis).—The company has increased its common stock from $1,000,000 to $2,000,000, and common stockholders are to be given a dividend of 50 per cent. of the new stock. The remaining 50 per cent. of the new stock will be sold from time to time to provide for improvements and additions.

Birmingham & Southeastern.—This company has made a mortgage securing $3,000,000 first mortgage 6 per cent. bonds of May 1, 1911-1961. The road runs from Union Springs, Ala., to Fort Davis, seven miles.

Bruce Mines & Algoma.—This road, which runs from Bruce Mines to Rock Lake, 17 miles, has been bought by George P. McCallum and H. Appleton, both of Sault Ste. Marie, Mich.

Central of Georgia.—Holders of certificates of deposit of the first income bonds are receiving $46.24 per thousand dollar bond for interest collected from the company for the two years ended June 30, 1909 and June 30, 1910.

Chicago, Milwaukee & Puget Sound.—See Northern Pacific.

Cleveland, Akron & Cincinnati.—This is the name of a new company which has taken over the Cleveland, Akron & Columbus and the Cincinnati & Muskingum Valley. Both of these roads are Pennsylvania subsidiaries which have heretofore been operated independently.

Chesapeake & Ohio of Indiana.—This company, which owns the "Chicago line" of the Chesapeake & Ohio, has filed a notice of an increase in its capital stock of $2,000,000, making the total authorized stock $5,000,000. In the notice the company says that it is obliged to issue certain first mortgage bonds and $2,000,000 stock against the surrender and cancellation by the holders thereof of certain other outstanding first mortgage bonds and for capital purposes.

As a result of a compromise agreement between the governor and the officers of the Chesapeake & Ohio of Indiana, the suit instituted by the governor several months ago to enjoin the company from realizing on action to mortgage its Indiana property, the old Chicago, Cincinnati & Louisville, for $40,000,000, was dismissed in the Cass Circuit Court recently. The $40,000,000 mortgage is to be cancelled and the bonds, already issued thereunder surrendered. A new mortgage securing a maximum amount of $30,000,000 of bonds at any time outstanding is to be executed by the company.

Gulf, Texas & Western.—The Texas Railroad Commission has authorized the company to register $522,000 additional bonds and $20,000 stock for improvements on the road and for extension from Megargel to Semour, 25 miles. There have been issued previously $1,700,000 bonds and $50,000 stock.

Louisiana Southern.—See St. Louis & San Francisco.

Manila Railroad.—The New York Stock Exchange has listed $996,000 additional "Southern Lines" first mortgage 4 per cent. bonds due 1939. There are now 90 miles of the Southern Lines in operation.

Marquette & Southeastern.—See Munising, Marquette & Southeastern.

Munising, Marquette & Southeastern.—This is the new name of the company which is now operating the Marquette & Southeastern and the Munising Railway. Heretofore the two roads have been operated jointly, but the two companies have had separate corporate existence. The Marquette & Southeastern runs from Big Bay, Mich., to Lawson, and the Munising Railway runs from Princeton, via Lawson, to Munising, with branches to Pictured Rocks, Cusino, etc. The total mileage is about 105 miles.

Munising Railway.—See Munising, Marquette & Southeastern.

National Railways of Mexico.—The gross earnings, which are not given in our monthly table of roads reporting to the Interstate Commerce Commission, for May, 1911, of the National Railways of Mexico, totaled $3,631,581, as compared with $5,690,016 in May, 1910. Net earnings in May, 1911 were $598,625 and in May, 1910 were $2,541,489.

New York Central & Hudson River.—This company has asked the New York Public Service Commission, second district, for authority to guarantee the principal and interest on $2,500.000 4½ per cent. bonds of the Clearfield Bituminous Coal Corporation.

Northern Central.—The Scott committee, representing the non-assenting minority stockholders, has issued a circular saying that every effort is being made to prevent the lease of the Northern Central to the Pennsylvania Railroad under the terms approved by the majority.

Northern Pacific.—A press despatch dated Hoguiam, Wash., says that all of the railway terminal properties of the railways entering Gray's Harbor will be turned over to a terminal company, in which the Northern Pacific, the Oregon-Washington Railway & Navigation Company and the Chicago, Milwaukee & Puget Sound will each hold an equal interest.

Oregon & Eureka.—This road, which was formerly operated by the Hammond lumber interests, has been taken over by the Southern Pacific and the Atchison, Topeka & Santa Fe. The road runs from Eureka, Cal., to Trinidad, 39 miles.

Oregon-Washington Railway & Navigation Company.—See Northern Pacific.

Pittsburgh & Shawmut.—Hallgarten & Co.; Rhoades & Co.; William Salomon & Co.; and the Guaranty Trust Co., all of New York, are offering $3,250,000 equipment and first lien collateral 6 per cent. notes of June 1, 1911-June 1, 1913 of the Pittsburgh & Shawmut at par. The notes would be secured by $3,350,000 Pittsburgh & Shawmut first mortgage 5 per cent. sinking fund bonds due December 1, 1959; $1,250,000 Allegheny River Mining Company first mortgage 5 per cent. bonds and by the pledge of equipment to cost about $640,000.

Pittsburgh, Ft. Wayne & Chicago.—The New York Stock Exchange has listed $3,338,300 additional guaranteed [by the Pennsylvania Company] special stock. Of the proceeds from the sale of this stock, $665,737 was spent for locomotives; $711,064 for gondola and flat cars; $181,188 for passenger, box and caboose cars; and the remainder for additions and betterments to the right-of-way.

Quebec & Lake St. John.—The bondholders prospective committee have arranged to pay the interest due July 1, 1911 on the new 4 per cent. debenture stock.

South Georgia Railway.—Middendorf, Williams & Co., Baltimore, Md., are offering $250,000 first mortgage 5 per cent. bonds of January 1, 1903-1923 at 94, yielding 5.75 per cent. income on the investment. This is the total authorized funded debt of the company and is at the rate of less than $5,000 per mile. The bonds are secured by a first mortgage on 51 miles of road, running from Adele, Ga., to Greenville, Fla. The road is laid with 56 and 60-lb. rail.

Southern Pacific.—See Oregon & Eureka.

Spokane & International.—As noted in the railway officers' news columns, officers of the Spokane, Portland & Seattle have been appointed officers of the Spokane & International also. Statement by the new president is in part as follows:

"J. P. Graves, since the disposition of a controlling interest about eighteen months ago, has, by request, retained direction of the company's affairs, with the understanding that at some future date he would be relieved of the responsibility. . . . These changes in management do not mean, and should not be construed to mean, any material change in the policies of the Spokane & Inland Empire system."

F. V. Brown, of Portland, counsel for the Northern Pacific; C. A. Coolidge, vice-president; Carl R. Gray, president; and George T. Reid have been elected directors succeeding J. P. Graves, A. L. White, W. G. Payne and Clyde M. Graves. W. G. Graves, F. B. Grinnell and Aaron Kuhn remain on the board of directors.

St. Louis & San Francisco.—This company has leased the Louisiana Southern. The Louisiana Southern runs from New Orleans, south along the Mississippi to Belair, 30 miles, with a branch to Shell Beach, 16 miles.